

All-Hazard Mitigation Plan

Marshall County, Indiana

2017

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Chapter 1 - Overview

Introduction

The Marshall County All Hazard Mitigation Plan is the guide for the county's assessment of hazards, vulnerabilities, and risks and includes the participation of a wide range of stakeholders and the public in the planning process. This plan aids the county, cities, and towns in preventing, protecting against, responding to, and recovering from disasters that may threaten the community's economic, social, and environmental well-being. This plan documents historical disasters, assesses probabilistic disasters through Hazus-MH and GIS analyses, and addresses specific strategies to mitigate the potential impacts of these disasters.

The Marshall County Emergency planning team and The Polis Center at Indiana University-Purdue University Indianapolis (IUPUI) and the developed the Marshall County Hazard Mitigation Plan (HMP) in 2010. They have again teamed up to complete the update for the 2017 plan.

The Marshall County All Hazard Mitigation Plan Update is developed to meet the "all hazards" mitigation approach which the Indiana Department of Homeland Security (IDHS) and FEMA recommend as an option to single hazard mitigation planning. While the plan considered all of the potential hazards, it should be recognized that only limited mitigation actions are feasible for some of these hazards since they are not site-specific or repetitive in nature.

Disaster Mitigation Act of 2000

With the development of the federal Disaster Mitigation Act of 2000, FEMA requires counties to have a Hazard Mitigation Plan (HMP) in order to be eligible for Hazard Mitigation Grant Program (HMGP) funds. The purpose of a HMP plan is, "to reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters." All jurisdictions must first have in place a multi-hazard mitigation plan and update the plan within a five-year time span. This plan update addresses changes in development, progress in local mitigation efforts, and alterations in priorities. This update will remain effective for 5 years from the community adoption.

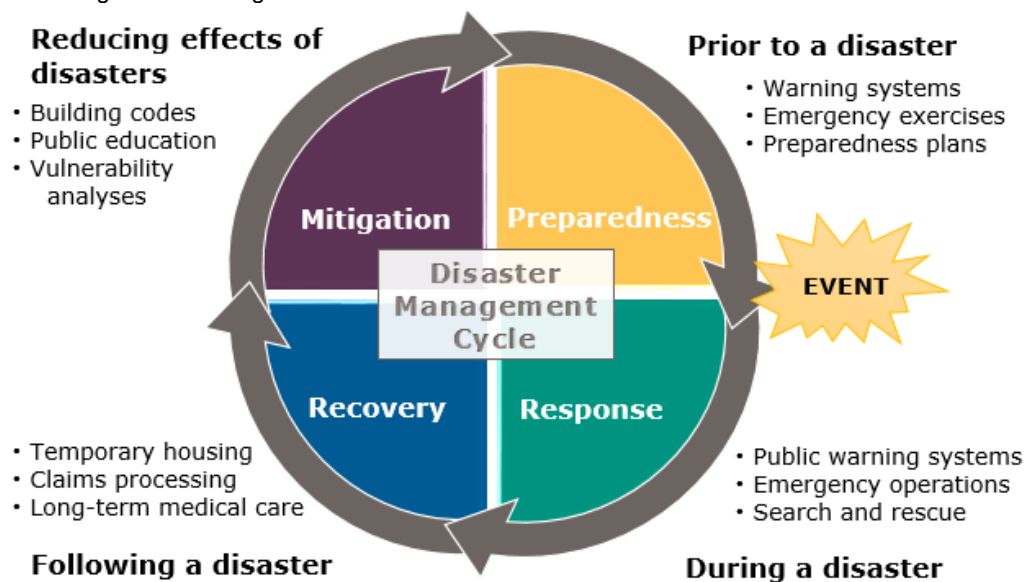
The procedures outlined in the plan are based upon guidance provided by the Federal Emergency Management Agency and is consistent with the requirements and procedures defined in the Disaster Mitigation Act of 2000. The analysis includes three components: 1) profile and analysis of

hazard events, 2) inventory of vulnerability assessment of community assets, and 3) development of hazard mitigation strategies.

Hazard Mitigation

Hazards are something that is potentially dangerous or harmful, often the root cause of an unwanted outcome. Hazards are included, both natural and human caused, which threaten loss of life and property in the county. Hazard mitigation is defined as any action taken to eliminate or reduce the long-term risk to human life and property from natural and technological hazards. The Federal Emergency Management Agency (FEMA) has made reducing hazards one of its primary goals.

Figure 1-1: An Integrated Planning Process



Hazard mitigation planning and the subsequent implementation of the projects, measures, and policies developed as part of this plan, is a primary mechanism in achieving FEMA's goal. Potential types of hazard mitigation measures include the following:

- Structural hazard control or protection projects,
- Retrofitting of facilities,
- Acquisition and relocation of structures,
- Development of mitigation standards, regulations, policies, and programs,
- Public awareness and education programs,
- Development or improvement of warning systems.

Local governments have the responsibility to protect the health, safety, and welfare of their citizens. This mitigation plan considers the importance of mitigation to:

- Protect public safety and prevent loss of life and injury.
- Reduce harm to existing and future development.
- Prevent damage to a community's unique economic, cultural, and environmental assets.
- Minimize operational downtime and accelerate recovery of government and business after disasters.
- Reduce the costs of disaster response and recovery and the exposure to risk for first responders.
- Help accomplish other community objectives, such as leveraging capital improvements, infrastructure protection, open space preservation, and economic resiliency.

Developing and putting into place long-term strategies that reduce or alleviate loss of life, injuries and property resulting from natural or human caused hazards accomplish this goal. These long-term strategies must incorporate a range of community resources including planning, policies, programs and other activities that can make a community more resistant to disaster. Mitigation planning efforts should both protect people, structures, while minimizing costs of disaster response and recovery. Mitigation is the cornerstone for emergency management and should be viewed as a method for decreasing demand on scarce and valuable disaster response resources.

Mitigation Planning Process

The process to update the HMP included a number of activities between the planning team and Polis. The planning team was comprised of a representative group of the county and incorporated communities. The emergency manager coordinated the planning team invitations to wide range of potential interested parties in the county and communities, including, elected and appointed officials, representatives of law enforcement, fire departments, public health, streets and highway coordinators, planners and engineers, local businesses, disaster relief, state IDHS district coordinators, and higher education officials. The team participated in a series of surveys and meetings, documented in the appendix, to complete the following 10-step process outlined by FEMA in the local hazard mitigation-planning handbook:

- Organize planning process. Involve key stakeholders and the public.
- Identify and screen major hazards for the county.
- Analyze the risks posed by those hazards.
- Review existing capabilities and resources and then identify the issues.
- Prioritize the hazards.
- Develop specific hazard mitigation measures. Include a timeline.
- Set implementation guidelines.

- Draft the plan.
- Adopt the plan.
- Implement, evaluate success and update regularly.

Each chapter was reviewed, revised and expanded upon with current information and included new feedback from taskforce members with an emphasis on the updating the goals, objectives and strategies. The mitigation planning requirements identified in 44 CFR 201.6 call for all jurisdictions participating in a multijurisdictional hazard mitigation plan to take part in the planning process. Examples of participation include, but are not limited to, attending planning meetings, contributing research, data, or other information, related to hazards and strategies and commenting on drafts of the plan.

State Mitigation Planning Team

The Silver Jackets program, administered by the US Army Corps of Engineers operate in states across the United States bring together multiple state, federal, and sometimes tribal and local agencies to learn from one another in reducing flood risk and other natural disaster. The Indiana Silver Jackets team works together toward its shared vision, to be a catalyst in developing comprehensive and sustainable solutions to natural hazard issues. The mission of the core agencies of the Silver Jackets team is to work together to:

- Enable the effective and efficient sharing of information
- Foster the leveraging of available agency resources
- Provide improved service to our mutual customers
- Promote wise stewardship of the tax-payers' investment

The Indiana Silver Jackets have led projects highlighted in this report, such as the Low Head Dam initiatives and the Fluvial Erosion & Non-Levee Embankment mapping projects.

Chapter 2 – Public Planning Process

This is a multijurisdictional plan that covers Marshall County, its school jurisdictions, and the incorporated communities within the county, which consist of Plymouth, Bremen, Bourbon, Culver, and La Paz. The community of Argos was invited but did not participate in the plan. The Marshall County risks and mitigation activities identified in this plan also incorporate the concerns and needs of townships and other entities participating in this plan.

Table 2-1: Jurisdiction Participation

#	Jurisdiction Name	Jurisdiction Type	2010 participant	2017 participant
1	Marshall County	County	Yes	Yes
2	Argos	Town	Yes	No
3	Bremen	Town	Yes	Yes
4	Bourbon	Town	Yes	Yes
5	Culver	Town	Yes	Yes
6	La Paz	Town	Yes	Yes

Planning Team

The Marshall County Emergency Management Agency Director heads the Marshall County Emergency Management Agency and is charged with developing the Hazard Mitigation planning team. Members of the planning team include representatives from various partners involved in hazard mitigation activities, those with the authority to regulate government, and stakeholders throughout the region. All members of the planning committee were actively involved in attending meetings, providing available Geographic Information Systems (GIS) data and historical hazard information, reviewing and providing comments on the draft plans, assisting in the public input process, and coordinating the county's formal adoption of the plan. A list of which particular meetings each team member attended is located in the Appendix E. Table 1 identifies the planning team members who attended meetings related to the plan update.

Table 2-1: Hazard Mitigation Planning Team

Name	Title	Organization	Jurisdiction
Clyde Avery	EMA Director	Marshall County Emergency Management Agency	Marshall County
Terry Greene	Chairman EMA Advisory Council	Marshall County Advisory Chair	Marshall County
Matthew Hassel	Sheriff	Marshall County Sheriff's Department	Marshall County
Les McFarland	Council President	Bourbon	Bourbon
Trend Weldy*	Town Manager	Bremen	Bremen
Jim Marquardt	Street Commissioner	City of Plymouth	Plymouth
Mark Senter	Mayor	City of Plymouth	Plymouth
Ryan Young	Councilman	La Paz Town Council	La Paz
Jonathan Leist	Town Manager	Culver	Culver
Jon Van Vactor	Councilman	County Council	Marshall County
Diane Ross	GIS Director	Marshall County	Marshall County
John A Seller	Member	HAM Club - Marshall County Amateur Radio Society	Marshall County
Michael Marshall	IT Director	Marshall County IT	Marshall County
Debbie Palmer	Marshall County SWCD	Marshall County Soil and Water County Department	Marshall County
Matt Neher	Fire Chief	Bremen Fire Department	Marshall County
Roger Ecker	Councilman	La Paz Town Board	La Paz
Sally Ricciardi	Council President	Culver Town Council	Culver
Jill Hassel	Vice President	Town of Bremen Plan Commission	Bremen
Mike Diels		Town of Plymouth	Plymouth

Review of Existing Plans

Marshall County and the local communities utilize land use plans, emergency response plans, municipal ordinances, and building codes to direct community development. The planning process also incorporated the existing natural hazard mitigation elements from these previous planning efforts. Table 2 lists the plans, studies, reports, and ordinances used in the development of the plan.

Table 2-2: Planning Documents Used for HMP Planning Process

Author (s)	Year	Title	Description	Where Used
United States Department of Agriculture	1978	Soil Survey of Marshall County, Indiana	Soil survey describing the soil variety of Marshall County	Section 3
D.J. Case & Associates	2005	Lake of the Woods, Marshall County, Indiana Watershed Management Plan	Marshall County Local Watershed Management Plan update	Section 3

Marshall County	2007	Marshall County, Indiana Zoning Ordinance	A tool for identifying future development areas within the county	Section 3,4,5
City of Plymouth	2008	City of Plymouth, IN Zoning Ordinance	Guide for growth and development	Section 3,4,5
Marshall County	2011	Storm Water Drainage and Sediment Control Ordinance Marshall County, Indiana	Water and drainage policy and guidelines	Section 4
Marshall County	2013	Marshall County, Indiana Comprehensive Plan	Plan intended to guide the growth of Marshall County	Section 3
Indiana Department of Homeland Security	2014	State of Indiana Multi-Hazard Mitigation Plan	Statewide hazard mitigation plan	Section 5
Marshall County	2014	Marshall County Comprehensive Emergency Management Plan	Procedures for the protection of personnel, equipment, and critical records and establishes policies to ensure the continuity of government and essential services during and after disasters.	Section 4,5,6

Planning Process Timeline and Steps

The Marshall County planning team met on February 22, 2017 for the HMP update kickoff. Prior to the second meeting, the team completed a survey related to the hazard rank and strategy status. The team then met on April 27, 2017 to discuss survey results. The team then confirmed that hazard priorities and any conflicting survey results for the county and each community.

The planning team invited the public to a meeting on June 29, 2017. During this meeting, the overall purpose of the plan was reiterated and public input was sought. The group reviewed a copy of the draft plan and was provided a presentation on the risk assessment and mitigation strategies. The draft plan was revised based on the team and public's comments following the meetings. Appendix E includes meeting minutes and invitations to participate and Appendix F includes the published announcement of the meeting.

The county considered including representatives for local businesses, non-profits, disaster relief, and surrounding local Emergency Managers that were encouraged to participate in the planning process.

The county continually works to engage with the public with posts community meetings and trainings on the county website as well as the Marshall County Emergency Management Facebook

page: www.facebook.com/pages/Marshall-County-Emergency-Management. In addition, a final copy of the plan will be available online through the county's website.

Chapter 3 – Community Profile

In order to provide a basic understanding of the characteristics of the community, this section offers a general overview of Marshall County including the physical environment, population, and the location and distribution of services.

General County Description

Marshall County is located in northeastern Indiana and is situated approximately 126 miles north of the capital city of Indianapolis. According to the US Census, the county covers 443.6 square miles and has an estimated population of 46,556. Plymouth is the county seat and is the largest city in the county.

The county is primarily composed of slightly rolling farmland with heavily-wooded areas adjacent to the major streams and wetlands. The northeast and central parts of the county contain the bulk of the population, living in incorporated communities, which are centralized in the communities of Plymouth and Bremen. The southern and western sections of the county are predominantly rural.

The six incorporated cities and towns within Marshall County consist of Argos, Bourbon, Bremen, Culver, La Paz, and Plymouth. The county contains ten townships, which include Bourbon, Center, German, Green, North, Polk, Tippecanoe, Union, Walnut, and West.

The communities of Marshall County have received recognition for their commitment to investing in the future and supporting business development. In 2017, Culver was named among the six finalist for the Stellar Communities Program for the second year in the row. Recently, the town of Argos adopted a new comprehensive plan with assistance from the Michiana Area Council of Governments. Marshall County has had several new development projects in recent years and is forming plans for more. As part of Marshall County's recent development trend, Elkay Wood Products is announcing its 2nd major expansion in just over 2 years. Elkay plans to invest \$3.9 million in expanding its operations in Culver. The Plymouth City Council encouraged local business growth by supporting a tax abatement for Farm Innovators, Inc., enabling the business to expand to Plymouth. In December 2016, it was announced that a study examining engineering, and

environmental impacts along the proposed path of a high speed rail line project was moving. Potentially, Plymouth is one of the many communities that will have a stop along the train route, linking it to Chicago, Fort Wayne, Columbus, and several other Midwest communities. According to the Marshall County Economic Development Council, limited service could begin as early as 2020.

Marshall County has primarily remained a quiet, agricultural area with small towns, which have maintained much of their historical and architectural heritage, but the county is also within easy access of the larger metropolitan areas of South Bend and Chicago. Plymouth is both the county seat and the only city in Marshall County. The county has a population density of 104.95 per square mile. The average household size is 2.7 persons compared to an average family size of 3.9 persons.

Historical Setting

Organized in 1836, Marshall County was named in honor of Chief Justice John Marshall, who was the fourth Chief Justice of the Supreme Court of the United States and who donated land for a railroad station. In the 1830s, populations were increasing rapidly and questions of forming new counties and county seats became an ongoing discussion. An Act to Organize the County of Marshall was approved on February 4, 1836 and was organized by the board of commissioners, comprised of Robert Blair, Abraham Johnson, Charles Ousterhout, and Jeremiah Muncy.

Prior to the European settlement in the area, the Potawatomi Native Americans hunted on the land that now consists of Marshall County. Originally, the area of Marshall County was a heavily timbered region, interspersed with prairies and wetlands. The *History of Indiana* notes that the region was particularly noted for its white burr, yellow and black oak, and hickory. As European settlers migrated into the area, the level forestland was found rich in timber and wildlife, and the area of Marshall County was included in the 1832 treaty of Tippecanoe River. Formerly considered poor farmland, the wetlands were drained and converted into fruitful tracks of land. The rivers and lakes permitted the creation of facilities for mills and machinery and helped with the transportation of goods to southern markets. The historic Michigan Road, which connected the Ohio River to Lake Michigan, was constructed through Marshall County making the county attractive for commerce and enabling further immigration. In the early 1800's, the Potawatomi relocated to Osawatomie, Kansas, where they shortly moved on to present day Oklahoma.

Early white settlers in the area primarily arrived from New England and traced their ancestry from English Puritans who settled New England in the colonial area. In honor of their heritage, the people of Marshall County named the community of Plymouth after the site where their *Mayflower* landed in 1620. Plymouth did not become an incorporated town until 1851; however, according to the *History of Indiana*, Plymouth was made the county seat in 1836, immediately following the county's creation. During the formation of the county, it was determined that Marshall would be attached to eighth judicial circuit of the state court and that the seat of justice would be permanently located at Plymouth.

Physical Characteristics

Climate and Precipitation

The Marshall County climate is characteristic of northern Indiana. The variables of temperature, precipitation, and snowfall can vary greatly from one year to the next. Winter temperatures can fall below freezing starting as early as October and extending as late as April. Based on National Climatic Data Center (NCDC) normal from 1971 to 2000, the lowest winter temperature is 16° F and the average high is 31° F. In summer, the average low is 62° F and average high is 83° F. Average annual precipitation is 40 inches throughout the year. The average seasonal snowfall is 70 inches.

Average wind speed and direction is 10 mph, generally from the south-southwest. Summer humidity is moderate, ranging from 60% for the mid-afternoon and rising during the evening to culminate with dawn humidity around 80%. The possibility for sunshine is 75% during the summer and 45% during the winter. Indiana is prone to strong thunderstorms that can produce strong winds, lightning, hail, and sometimes tornadoes. Historically, these storms can occur at almost any time throughout the year, but are most common in the spring and summer months.

Geology and Topography

The landscape of Marshall County is an upland consisting of broad flatlands, undulating plains, and lower areas along streams and drainage ways. The highest point in the county is about 895 feet above sea level, near the junction of Kenilworth Road and Indiana Route 110 in Green Township. The lowest point of the county is about 705 feet above sea level and is in the area directly north of US Route 6 where the railroad crosses the St. Joseph County line in Polk Township.

Marshall County's topography is dominated by the Plymouth Morainal Complex while the far western edge of the county is part of the Kankakee Drainage ways and the southeastern corner is part of the Warsaw Moraines and Drainage ways. An extensive tract of flatness marks eastern Marshall County and is a portion of the upland plain that has not yet been severely entrenched and deeply grooved by streams. The Plymouth Morainal Complex in Indiana is comprised of disorganized ridged till and stratified drift of northern, northeastern, and eastern source. The Kankakee Drainage ways are broad tracts of sandy outwash, lake plains, and scattered clusters of dunes. The Warsaw Moraines and Drainage ways are characterized by ridged till of eastern source crossed by tunnel-valleys and bounded by an alluvial-fan apron.

Soils

Soil functions as a vital part of the natural environment and sustains life by supporting plant and animal life, helping maintain the levels of atmospheric gases, and acting as a filtration system for surface water.

The mission of the Marshall County Soil and Water Conservation District is to provide a means for all interested people in the community to work together to administer programs to preserve, protect and improve soil, water, air, plant, and animal resources for future generations.

The Marshall County Indiana Soil and Water Conservation District has been the recipient of several grants in order help the community engage with educational opportunities, address environmental concerns, and to develop further knowledge of conservation. Using a grant from Clean Water Indiana, the Marshall County Soil & Water District is working on a soil health program in order to improve water quality by helping producers utilize all aspects of the conservation cropping system. Over a third of Marshall County's soil is well drained while the remainder of the soil drainage types vary from excessively drained to somewhat poorly drained.

Land Use and Ownership

Agriculture is the predominant land use in Marshall County. Other significant land uses are industrial and residential. Recent or proposed development, especially in Special Flood Hazard Areas (SFHAs) and floodways, must be carefully evaluated to ensure that no adverse impacts occur as a result. Development, whether it is a subdivision or a single lot big box commercial outlet, can result in large amounts of fill and other material being deposited in flood storage areas.

The Marshall County Comprehensive Plan prescribes that the following policies be used when deciding land use within the county:

- Establish multiple agricultural zoning districts.
- Support cluster subdivision design for rural residential development.
- Require high density residential development to be served by public sewer and water utilities.
- Support the creation of a foundation to receive and administer conservation easements.
- Require municipal sewer and water service for large scale subdivisions.
- Encourage cities and towns in Marshall County to require annexation for infrastructure extensions.
- Require lot owners in any large scale subdivisions to be responsible for street lights, street signs, and open space.
- Consider the county as a whole in efforts to address affordable housing.
- Require high-quality development design in designated commercial areas.
- Support the concentration of commercial development in key areas around the county.
- Rezone land for commercial development only after careful consideration of the potential impacts of such development.

Agriculture

As illustrated in the map of Marshall County Agricultural Areas, the densely cultivated areas, which are more than 75% cultivated, are predominantly in the central and northern parts of the county. The majority of farms and confined feeding operations are located in the southern part of the county. Some of the non-agricultural areas of the county correspond with the locations of the Menominee Wetland Conservation Area in the west of the county.

The 2012 U.S. Census of Agriculture reports that there are 878 farms in the county, covering 206,306 acres. Of this farming land, 88.1% is cropland, 6.1% is woodland, and 5.8% is classified as “other uses.” In contrast, 71.5% of Indiana is harvested cropland and 45.3% of the state is woodland, but of the land on farms, 85.5% is cropland and 7.1% is woodland, meaning Marshall County has a higher percentage of harvested cropland on farms than the state as a whole. Approximately, 206,306 acres of Marshall County were actively farmed in 2012, which represents a 15% increase in the number of acres used for farmland since 2007.

Table 3-1: Agriculture Production 2016

Marshall	Harvested acres	Planted acres	Yield bushel/acre
Corn	87,000	92,000	169
Soybeans	63,700	64,100	54.4
Hay & Alfalfa	6,100	24,100	3.95
Hay (excl Alfalfa)	1,000	3,040	3.05
Winter wheat	2,200	3,100	76.8

Table 3-2: Land in Farms According To Use (acreage)

	2007	2012
Other Cropland	3,949	4,797
Woodland	521	749
Permanent pasture & rangeland	4,396	5,160
Land in farmsteads, homes, buildings, livestock facilities, ponds, roads, wasteland, etc.	6,618	6,766
Pastureland, all types	8,660	7,820
Total	24,144	25,292

Table 3-3: Conservation and Crop Insurance

	2007	2012
Land enrolled in Conservation Reserve, Wetlands Reserve, Farmable Wetlands, or Conservation Reserve Enhancement Programs		
Farms	160	128
Acres	5,226	4,316
Land enrolled in crop insurance programs		
Farms	122	129
Acres	65,891	99,583

Table 3-4: Farm Statistics

Marshall	2007	2012	Difference
Farms (producers)	866	878	+12
Total Farms	317	366	+49
Average Farm Income (gross before taxes & expenses)	\$61,843	\$107,284	+45,441

Managed Lands

The Department of Natural Resources maintains an inventory of managed properties. These natural and recreation areas are managed by either the, DNR Fish & Wildlife, DNR Nature Preserves, federal, local and non-profits and is maintained by the Indiana Natural Heritage Database. The county has 22 managed properties and their classification type is displayed in a map located in Appendix A.

Marshall County is home to several parks and the Menominee Wetland Conservation Area, which is 830 acres and is managed by the Indiana Department of Natural Resources. By establishing conservation areas and parkland, the county is able to preserve plant and animal species and combat air, land, pollution prevention and water quality issues.

Endangered and Threatened Species

The Federal Endangered Species Act of 1973 (Act) describes two categories of declining species of plants and animals that need the Act's protections – endangered species and threatened species – and provides these definitions, “Endangered species are those species that are in danger of extinction throughout all or a significant portion of its range. Threatened species are those species that are likely to become an endangered species within the near future throughout all or a significant portion of its range.” The following table identifies the endangered or threatened species within the county and identifies the habitat characteristics where the species are identified within the county.

Table 3-5: County Endangered or Threatened Species 2017

Species	Endangered/ Threatened	Habitat
Indiana bat (<i>Myotis sodalist</i>)	Endangered	Hibernation occurs in caves and mines, with swarming in surrounding wooded areas. Summer roosting and foraging habitat occurs in wooded stream corridors and in bottomland and upland forests and woods.
Northern long-eared bat (<i>Myotis septentrionalis</i>)	Threatened	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods.
Running buffalo clover (<i>Trifolium stoloniferum</i>)	Endangered	Disturbed bottomland meadows

The US Fish and Wildlife service has more information on specific species fact sheets, brochures, and pamphlets are available for each identified species at:

<https://www.fws.gov/midwest/endangered/saving/outreach.html>.

Bald eagles are no longer protected under the federal Endangered Species Act and Section 7 consultation with the U.S. Fish and Wildlife Service is no longer necessary. However, the bald eagle remains protected under the Bald and Golden Eagle Protection Act.

The complete Indiana Bat, Kids, and Caves - Oh My! activity book for teachers is a 157-page pdf file developed in 2007 by the Education Department of Evansville's Mesker Park Zoo & Botanic Garden

and was sponsored by the US Fish & Wildlife Service. This document provides students and teachers with a guidebook on the Indiana bats habitat, conservation, and numerous activities.

Pollution

The US Environmental Protection Agency manages the Brownfield and Superfund programs, which provide resources to local and state partners to address a hazardous substance, pollutant, or contaminants. These programs provide increases to local tax base, facilitates job growth, utilizes existing infrastructure, takes development pressures off of undeveloped, open land, and both improves and protects the environment. The primary difference between the programs is that Brownfields are focused on the remediation of active hazardous sites and also regulate the transportation of hazardous waste in which the property owners are known and are currently using managing, or disposing hazardous waste.

Hydrography

Water resources within the county are vital to the community because they provide recreational as well as enhanced economic opportunity. Important water resources include surface and groundwater from aquifers, watersheds, lakes, rivers and wetlands providing water for riparian habitats, fish, wildlife, household, livestock, recreation and aesthetic and industrial uses.

The DNR and IDEM manage many of the water regulated state programs. The DNR administers permit programs for lakes and streams related to quantity and is the Cooperating Technical Partners for the FEMA flood-mapping program. IDEM manages the EPA related quality monitoring in coordination with the assistance of the local community officials.

For more details on the roles and responsibilities of local governments & state agencies with regards to water resource management visit the Indiana Drainage Handbook:

<http://www.in.gov/dnr/water/4893.htm>.

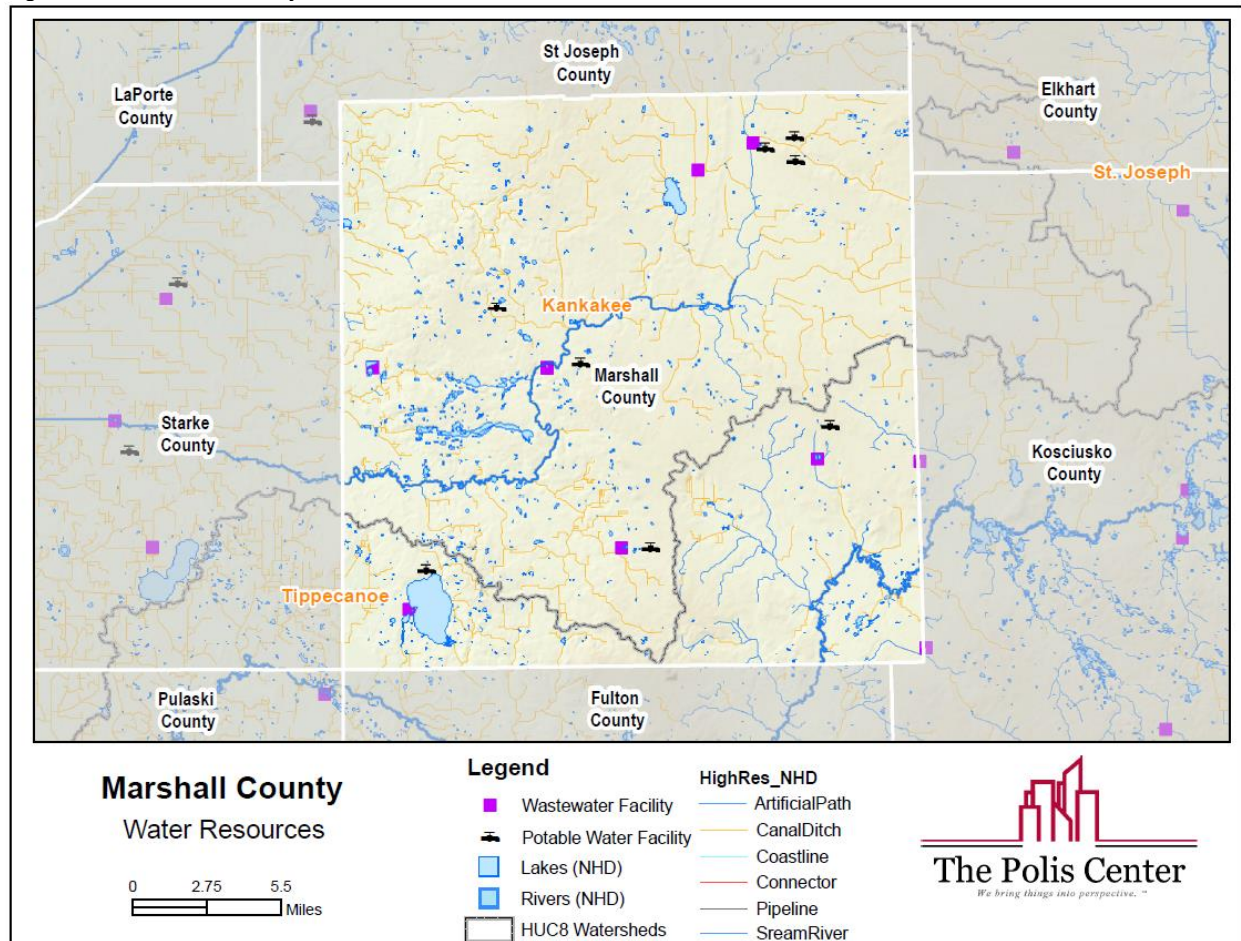
The Headwaters Yellow River Watershed encompasses approximately 187,423 acres of land across Marshall, Kosciusko, Elkhart, and St. Joseph Counties, and the communities of Plymouth, Bremen, La Paz, Lakeville and Nappanee.

Watersheds

Marshall County is located within two major watersheds: Tippecanoe and Kankakee watersheds as shown in the water resources map. North and central Marshall County are part of the Kankakee

watershed while the southern extremity and southeast corner of the county is in the Tippecanoe watershed.

Figure 3-1: Marshall County Water Resources



Rivers

The National Hydrography Dataset (NHD) is the surface water component of The National Map. Managed by the USGS. The NHD data is a digital vector dataset used by geographic information systems (GIS). It contains features such as lakes, ponds, streams, rivers, canals, dams and stream gages. These data are designed to be used in general mapping and in the analysis of surface-water systems. The NHD data provides a flow network that allows for tracing water downstream or upstream. It also uses an addressing system based on reach codes and linear referencing to link specific information about the water such as water discharge rates, water quality, and fish population. Using basic NHD features like flow network, linked information, and other

characteristics, is possible to study cause and effect relationships, such as how a source of poor water quality upstream might affect a fish population downstream.

Indiana recently concluded a statewide project led by the Indiana GIO and Geographic Information Council (IGIC) to improve the accuracy and density of the statewide NHD. Indiana Geographic Information Council has entered into a USGS partnership agreement to identify the process for state and local stewardship and maintenance of the Indiana high resolution NHD. You can download the data at: <https://nhd.usgs.gov/data.html>.

The Yellow River is the principal stream in the County and cuts through the City of Plymouth. Numerous tributaries feed into the Yellow River primarily east or northeast of Plymouth. The Marshall County NHD contains 533 miles of streams and rivers. According to the Indiana Natural Resources Commission, the Yellow River is Navigable to Plymouth.

The Yellow River is highly susceptible to bank stabilization erosion and continues to migrate within the portions of the alluvial channel that are not protected. Excessive sediment transport has been the focus of many collaborative research efforts. The Yellow River is the focus of many projects centered on developing of Best Management Practices (BMP) throughout the watershed. Recent projects include initiations to contain the pollutants, as well as determine understanding stabilization methods viable in the unique geography of the region.

The Headwaters Yellow River Watershed Management Plan was initiated by the Marshall County Soil and Water Conservation District in order to identify critical areas within the watershed contributing to impaired water bodies containing E. coli and excess phosphorus. The Indiana Silver Jackets and the Center for Earth and Environmental Science at IUPUI have been coordinating research development methods developing BMP for managing excessive sediment loads and bank stabilization techniques.

Lakes

The DNR Department of Fish and Wildlife maintains a list of the lakes in Indiana and identifies nineteen lakes within Marshall County. Of these lakes, there are no designated Public Freshwater Lakes, which are regulated by the DNR Division of Water, under Lake Preservation Act (I.C. 14-26-2) and/or Lowering of 10 Acre Lakes Act or "Ditch Act" (I.C. 14-26-5).

The Indiana General Assembly defines "lake" as designating a reasonably permanent body of water that is substantially at rest. Lakes provide a habitat for a variety of fish and wildlife and

drinking water. Lakes can function as a potential source of transportation and support recreational and commercial fishing industries.

Public Lakes are determined by

- existed on March 12, 1947
- is substantially at rest in a depression in the surface of the earth that is naturally created
- is of natural origin or part of a watercourse, including a watercourse that has been dammed
- covers an area of at least five (5) acres within the shoreline and water line, including bays and coves

Table 3-6: Marshall County Lakes

Lakes	Public Lakes
Cook Lake	
Dixon Lake	
Eddy Lake	
Flat Lake	
Gilbert Lake	
Holem Lake	
Houghton Lake	
Koontz Lake	
Lake Latonka	Not Public Freshwater
Lake Maxinkuckee	
Lake of the Woods	Wooded Lake
Lawrence Lake	
Lost Lake	
Mill Pond	
Myers Lake	
Pretty Lake	
Thomas Lake	
Zehner Millpond Lake	

The goal of the Division of Fish & Wildlife's Lake and River Enhancement (LARE) Program is to protect and enhance aquatic habitat for fish and wildlife, and to insure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce non-point sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality standards.

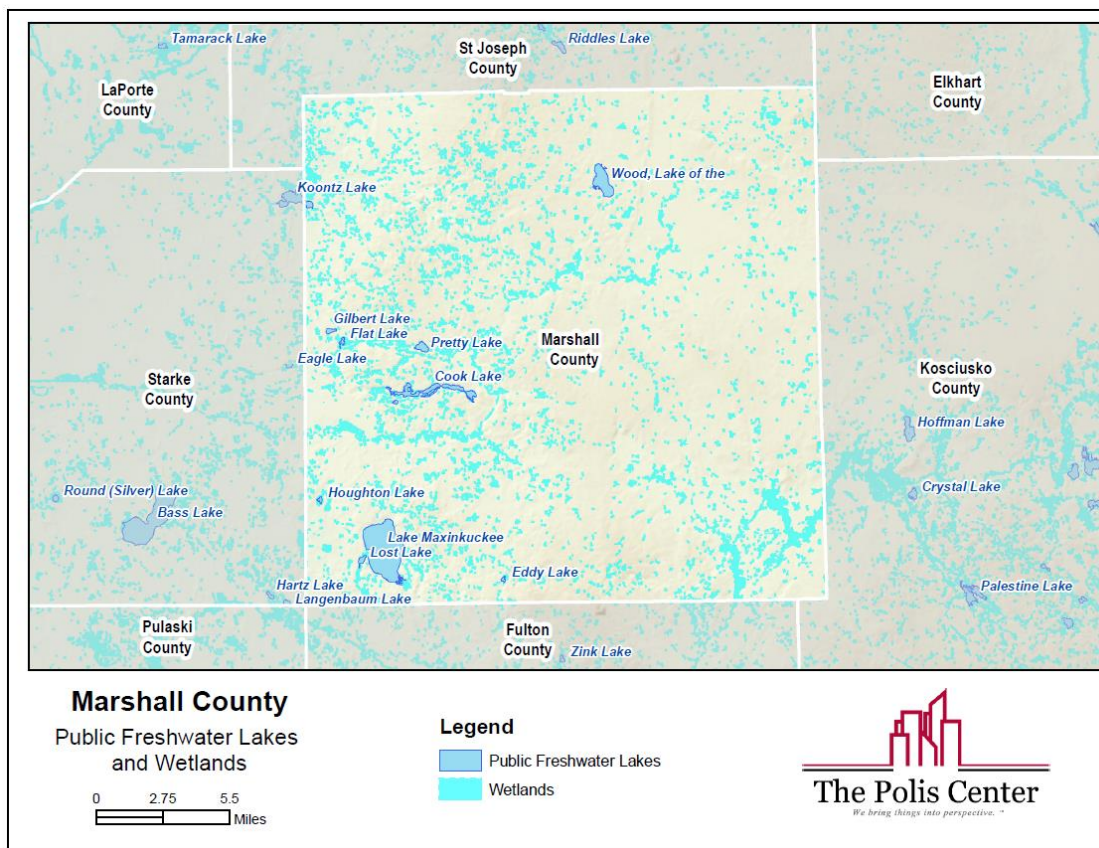
Example of LARE projects include matching federal funds for qualifying projects, Engineering designs and construction of remedial measures, water quality monitoring of public lakes,

management of invasive aquatic vegetation sediment removal from qualifying lakes, and logjam removal from qualifying rivers.

Wetlands

The US Environmental Protection Agency and the Indiana Department of Environmental Management have identified Indiana's wetlands and other aquatic resources as important features to protect and wisely use for the benefit of present and future generations. Before agriculture became more widespread, Indiana was composed of numerous broad expanses of poorly drained wetlands. Broadly defined, the term "wetlands" commonly refers to low depressions in the landscape covered with shallow and intermittent water standing long enough to be capable of supporting hydrophytic vegetation. According to the United States Protection Agency, wetlands differ in size, shape, and types of wet environment and derive their unique characteristics from climate, vegetation, soils and hydrologic conditions. Additionally, the Indiana Department of Environmental Management identifies wetlands as possessing soils, which differ from soils in dry areas, exhibiting hydric characteristics that show the soil developed in saturated conditions. Wetland communities include bogs, dunes, swales, fens, flatwoods, floodplain forests, marshes, ponds, lakes, sedge meadows, seeps, streams, creeks, rivers, and swamps. Wetlands are classified according to their depth of water, total area, and seasonal life span. The IDEM regulates the wetlands in Indiana. The county is the responsible agency for the administration of the North American Wetlands Conservation Act (NAWCA).

Figure 3-2: Public Freshwater Lakes and Wetlands



Originally, wetlands were located throughout the entire state of Indiana. In southern Indiana, floodplain and swamp forests were also widespread, particularly in the southwest lowlands. In south central Indiana, counties rich in limestone frequently have areas with dissolved bedrock, creating many sinkholes, springs, and lowland swamps. With the advent of intensive agriculture practices and the application of land drainage techniques, many of the wetlands located on lands that were flat and suited to agricultural use have been drained.

Wetlands are vital features of the Indiana landscape that provide beneficial services for people and wildlife including: protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters and maintaining surface water flow during droughts and dry periods.

Table 3-7: Wetland Classification by Type

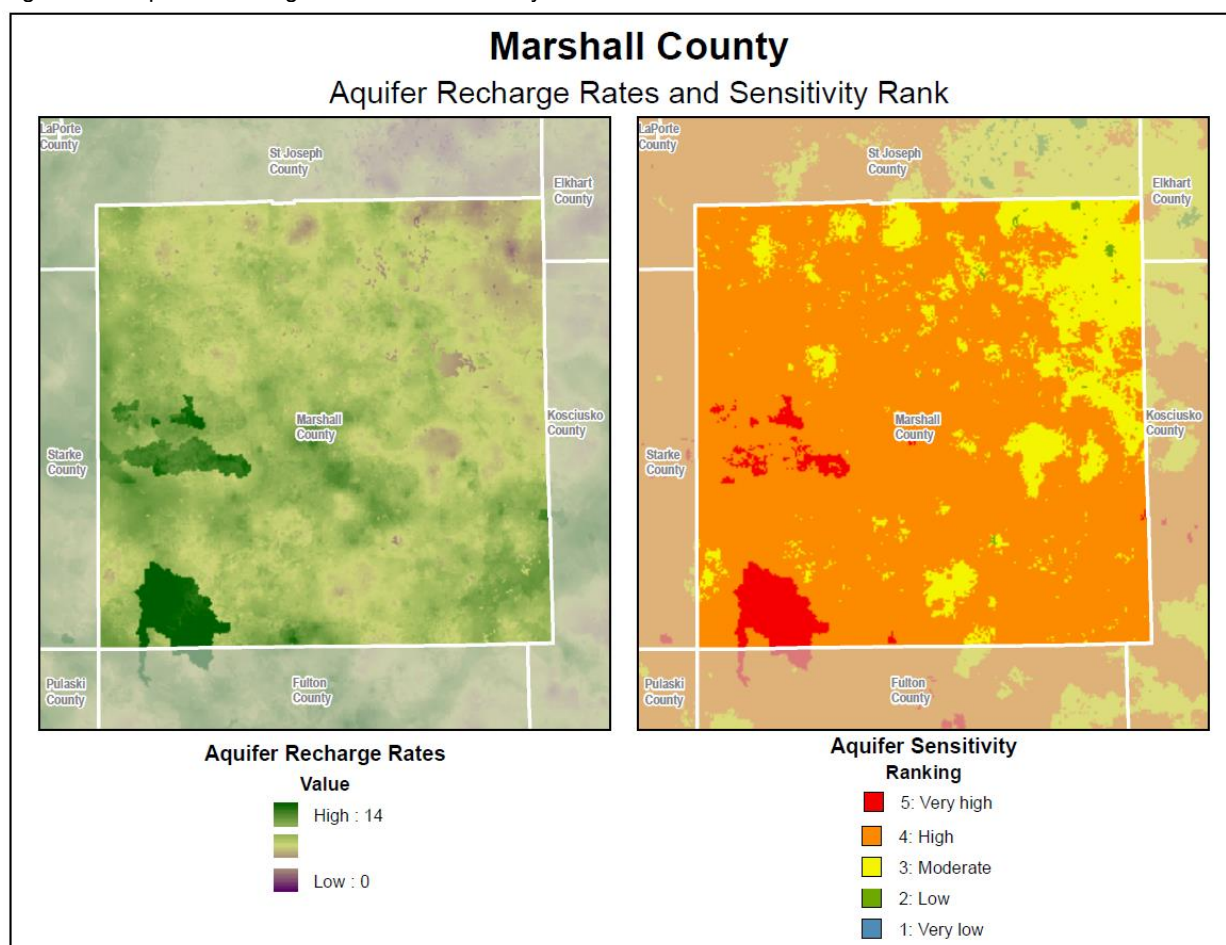
Wetland Type	acres
Freshwater Emergent Wetland	288
Freshwater Forested/Shrub Wetland	5,188
Freshwater Pond	2,641
Lake	789
Riverine	250
Total	9,156

The Marshall County Indiana Soil and Water Conservation District has received grants for a couple of projects related to wetland conservation. In order to identify and prioritize ways of improving water quality in the Upper Headwaters Yellow River Watershed, the Upper Headwaters Yellow River Watershed Management Plan was developed to increase knowledge of best management practices throughout the watershed. Allowing for prioritization protection and restoration of wetlands, the Landscape Level Wetland Functional Assessment analyzes existing wetlands to determine their functional significance in the Headwaters Yellow River Watershed.

Water Pollution

Water pollution contaminates lakes, rivers, wetlands, aquifers, and groundwater, and leaches into the surrounding soil. Consisting of any contamination of water with chemicals or other foreign substances that are detrimental to human, plant, or animal health, water pollution places risks on downstream water quality and water supply. Impaired waters containing pollutants can create a hazard affecting wildlife and plant species and can potentially poison underground streams and the wells of people living in the surrounding area, depriving communities of a reliable source of life-giving water and injuring opportunities for economic development and recreation.

Figure 3-3: Aquifer Recharge Rates and Sensitivity Rank

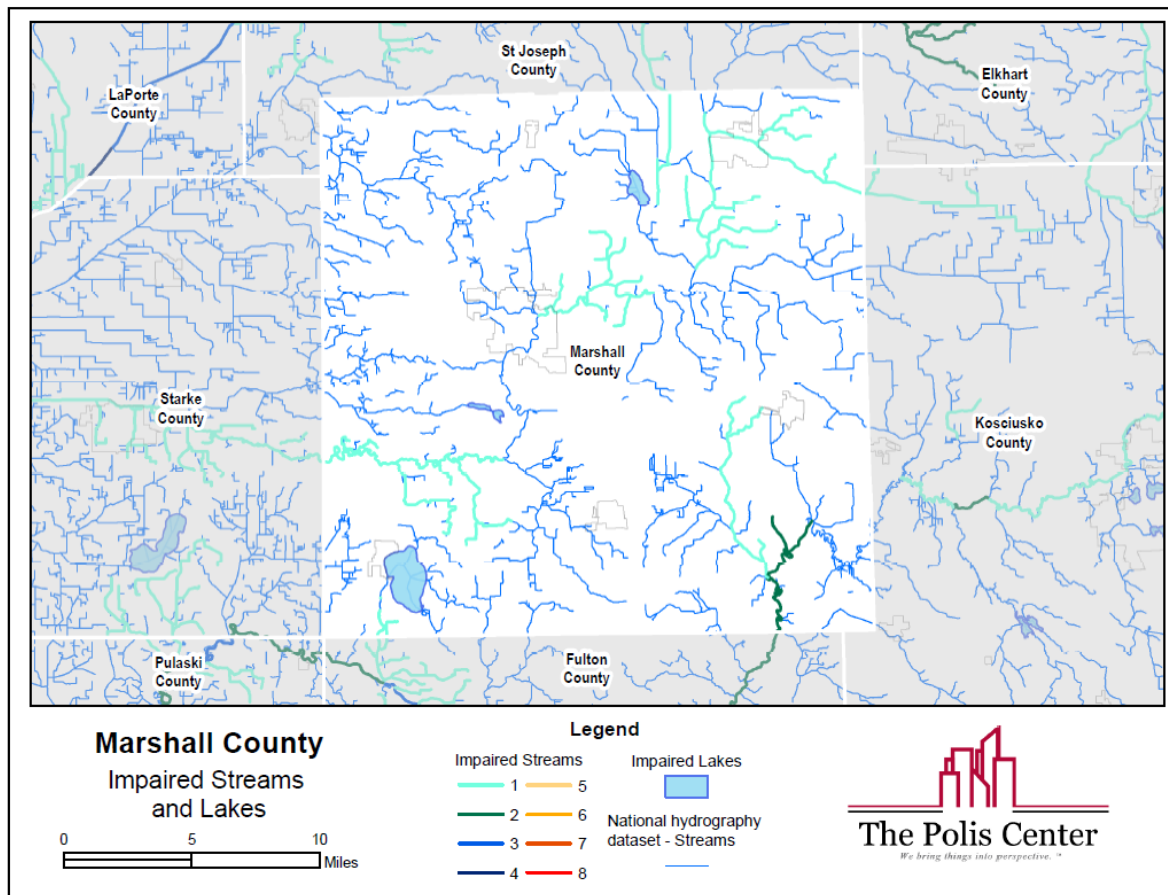


Sewage, wastewater, marine dumping, industrial waste, radioactive waste, oil pollution, and underground storage leaks are some of the most common forms of water pollution. Inadequately engineered hillside construction can endanger downslope development, and erosive soils have been known to generate stream siltation and compromise water quality. The Federal Clean Water Act encourages communities to reduce discharges of storm water pollutants and ensure that waters are safe for fishing, swimming, and drinking. In National Aeronautics and Space Administration's abstract on the Clean Water Act, agricultural runoff is estimated to have resulted in the erosion of 2.25 billion tons of soil and the deposit of large amounts of phosphorus and nitrogen into many waters.

The Federal Clean Water Act provides funding to states and communities to help them meet their clean water infrastructure needs and protects valuable wetlands and other aquatic habitats through a permitting process that ensures development and other activities are conducted in an environmentally sound manner. IDEM is required to assess the quality of the waters in the state of

Indiana and produce a list of waters that are impaired along with the specific impairments. The following figure displays the impaired streams and lakes in Indiana.

Figure 3-4: Impaired Waters



People

Populations

In 1980, Marshall County had a population of 39,155, and the population increased by 11.7 percent between 1970 and 1980. As of 2016, an estimated 46,556 people reside in Marshall County with a population density of 105 people per square mile. A region's economy thrives or dives because of the people who choose to live there. That choice may occur by being born in the community and desiring to stay, or as a deliberate result of choosing to relocate from somewhere else. Monitoring change in the size and movement of population is an important barometer of well-being and a vital part of preparing for the future.

Table 3-8: Population Over Historical Time

	1990	2000	2005	2010	2016
Total Population	42,182	45,126	46,549	47,007	46,556
Change Since 1990		2,944	4,367	4,825	4,374
Pct. Change Since 1990		7.0%	10.4%	11.4%	10.4%

Examining the alterations in the population of the county between 2009 and 2015 along with the shifts within the communities from the beginning of the century and 2015 helps provide perspective on the changing communities of Marshall County.

Comparing and contrasting the data from the beginning of the century and 2015 reveals the largest percent increases in population occurring in the northern towns of La Paz (11.76%) and eastern town like Bourbon (4.08%). With the exceptions of Culver, a community in the southwestern part of the county, all incorporated communities showed population growth.

Table 3-9: Population Change by Community

Community	2000 Population	2016 Population	% Population Change
Argos	1,692	1,647	3.17%
Bourbon	1,708	1,777	4.08%
Bremen	4,474	4,552	1.74%
Culver	1,496	1,412	-5.61%
La Paz	493	551	11.76%
Plymouth	9,853	9,949	0.97%
Marshall County	45,126	46,556	3.17%

Migration trends inform hazard mitigation by highlighting areas of population growth and decline, revealing immigration and emigration patterns, and informing public officials of changes in net adjusted gross income (AGI) because of migration.

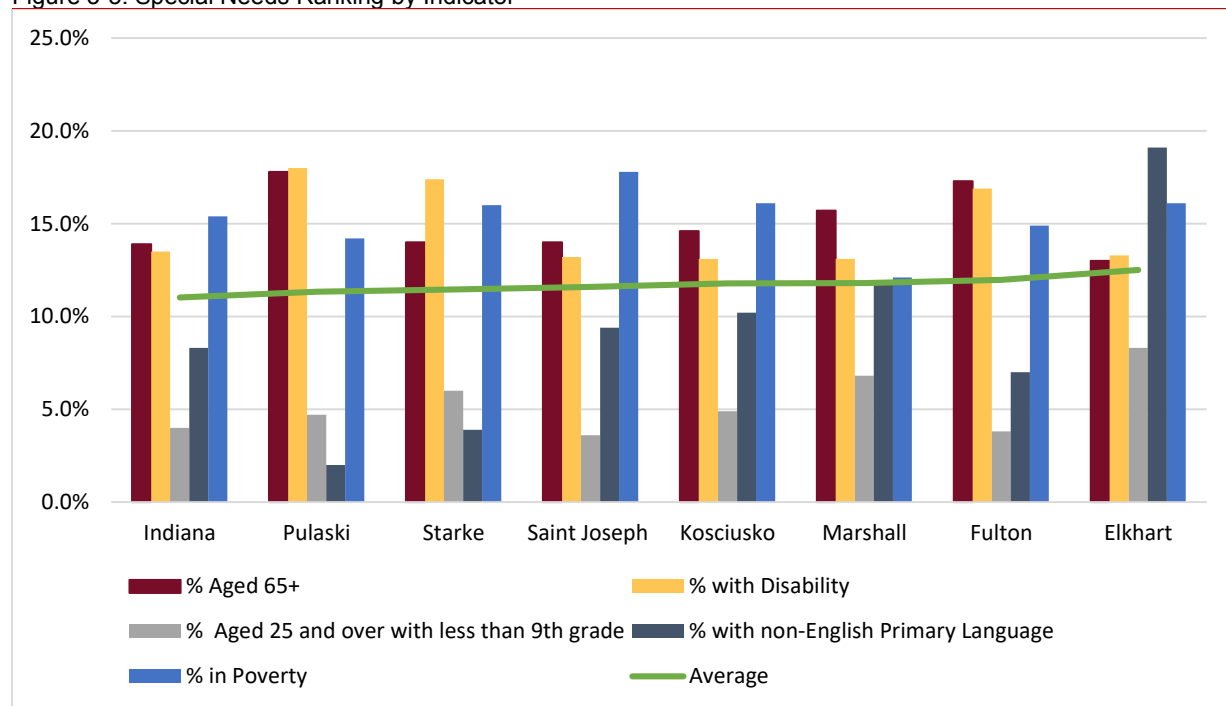
Table 3-10: Components of Population Change 2015 to 2016

	Number
Net Domestic Migration	-289
International Migration	25
Natural Increase (births minus deaths)	94
Births	565
Deaths	471

Age and Sex Characteristics

Some populations may require special attention in mitigation planning because they may suffer more severely from the impacts of disasters. These groups, termed special needs populations, can pose an added difficulty to hazard response and recovery and public resources. It is important to identify these populations and develop mitigation strategies to help them become more disaster-resilient. Although there are numerous types of vulnerable populations, there are five focus groups, which include low-income citizens, older adults, people who don't speak English at home, people with disabilities, and people without high school diplomas, highlighted in the figure below. Marshall County is compared to the nearby counties, as well as to Indiana, by averaging the percent population of each special needs category within the county/state. Of the eight geographies we compared (one state and seven counties), Marshall County ranks sixth, meaning it has a relatively high special needs population in the assessed area.

Figure 3-5: Special Needs Ranking by Indicator



Explanation of Special Needs Indicators:

- Percent population speaking language other than English at home
- Percent of all people whose income in the last 12 months is below poverty level
- Percent of population with a disability within the civilian non-institutionalized population
- Percent of population age 65 and over
- Percent of population with 25 years old and over who have completed less than 9th grade

Marshall County has a relatively low poverty rate but a slightly higher than average percent of people with a non-English primary language and people aged 25 and over with less than a 9th grade education. The remaining factors were on average with the other county data. People who do not have English as their first language and people with less than high school education may require special attention to ensure that they are reached and properly communicated with during disaster warnings or in the event of a hazard. In the event of a disaster, elderly and disabled citizens have particular challenges and concerns. They may require life-sustaining medication, electricity-operated medical equipment, and special mobility assistance. They may also require special temporary housing needs that can accommodate physical disabilities/limitations and varied levels of income. Examples of activities to improve emergency mitigation and preparedness for the elderly population include, but is not limited to, the following:

- Evacuation exercises for communities and elderly care facilities
- Fan distributions
- Public materials on when and how to shelter in place
- Training for emergency shelter staff
- Development of resource guide for seniors with available housing, medical, and basic needs services
- Development of accessible media announcements

Understanding more about the community age breakdown can be helpful in developing public outreach campaigns and understating where to target emergency service needs. The figure representing the age distribution of the Marshall County population reveals a gradually aging population. The percent of the population aged 65 and older is great in 2015 than in 2010, and the median age in Marshall County is 39.5 compared to the Indiana median age of 37.5.

Table 3-11: Population Estimates by Age in 2015

	Number	Pct. Dist
Preschool (0 to 4)	2,919	6.20%
School Age (5 to 17)	8,989	19.20%
College Age (18 to 24)	3,926	8.40%
Young Adult (25 to 44)	10,645	22.80%
Older Adult (45 to 64)	12,637	27.00%
Older (65 plus)	7,741	16.60%

Economy

Data on the types of housing and types of households can potentially provide insight into how to further develop mitigation strategies or align messages to particular groups of citizens. Similar to

the rest of the state and the nation, the average household size is decreasing which can primarily be attributed by the overall rise in the elderly population, and the delays in beginning families and overall smaller family sizes than in the past.

In 2015, the county had an average household size of 2.7 people and average family household size of 3.9. The county ranks relatively high compared to the US average of owner occupied housing and is relatively low for seasonal or recreational use.

Since the year 2000, the county has experienced a positive 36.3% increase in wage growth. Marshall County's median family income of \$59,601 is slightly less than, but comparable to, the Indiana median family income of \$61,119.

Table 3-12: Income and Wage

	Number
Median family income in 2015 (ACS)	\$59,601
Median household income in 2015 (ACS)	\$48,485
Average Wage Per Job in 2015 (BLS)	\$35,659
Wage Growth since 2000 (BLS)	36.30%

Housing

Approximately, 69.1% of Marshall County households consist of families compared to 66.9% of people in Indiana living with families.

Table 3-13: Households in 2015

	Number	Pct. Dist
Total Households	17,324	100.00%
Family Households	11,976	69.10%
Married with Children	3,778	21.80%
Married without Children	5,723	33.00%
Single Parents	1,200	6.90%
Other	1,275	7.40%
Non-family Households	5,348	30.90%
Living Alone	4,643	26.80%
Average Household Size	2.7	
Average Family Household Size	3.9	

Table 3-14: Housing Units in 2015

	Number	Rank in U.S.	Pct. Dist.	Pct. Dist. in U.S.
Total Housing Units (ACS estimate)	19,948	1,109	100%	100%
Occupied	17,324	1,060	86.8 %	87.7 %
Owner Occupied	13,319	990	66.8 %	56.0 %
Renter Occupied	4,005	1,229	20.1 %	31.7 %
Vacant	2,624	1,271	13.2 %	12.3 %
For Seasonal or Recreational Use	1,108	869	5.6 %	4.0 %

Workforce

In recent years, Marshall County has incurred the most growth in the number of medium sized business establishments with 50-99 employees while larger business corporations with 100 plus employees have experienced a negative percent change.

During 2013, Marshall County reached its highest rate of unemployment (13.5% unemployed) in the past decade. Unemployment among the labor force has slowly diminished since reaching its peak in 2009, and in 2015, the county unemployment rate was the lowest it has been since 2006.

Table 3-15: County Business Patterns, 2014

Business by Number of Employees	Establishments	Number Change	Percent of Change	Percent of Total
1-9 employees	745	-44	-5.60%	71.00%
10-19 employees	137	-16	-10.50%	13.10%
20-49 employees	91	4	4.60%	8.70%
50-99 employees	40	8	25.00%	3.80%
100 plus employees	36	2	5.90%	3.40%
Total	1,049	-46	-4.20%	100.00%

Table 3-16: Labor Force Estimates

Year	Labor Force	Employment	Unemployment	Area Rate	State Rate
2006	23,038	21,800	1,238	5.4	5
2007	22,795	21,693	1,102	4.8	4.6
2008	23,183	21,490	1,693	7.3	5.9
2009	22,539	19,497	3,042	13.5	10.3
2010	23,476	20,823	2,653	11.3	10.4
2011	23,453	21,231	2,222	9.5	9.1
2012	22,969	21,085	1,884	8.2	8.3
2013	23,131	21,420	1,711	7.4	7.7
2014	23,730	22,432	1,298	5.5	5.9
2015	24,078	23,080	998	4.1	4.8

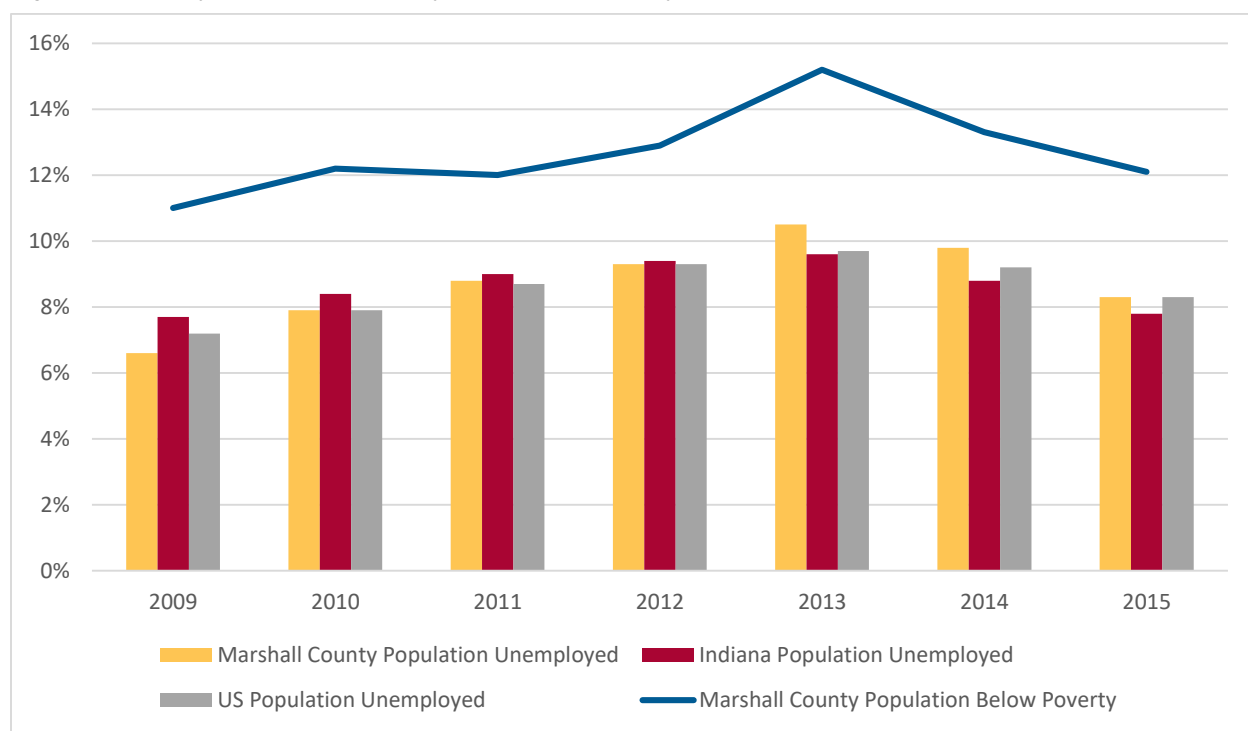
Employment

The Average Annual Earning by Sector table reveals that, from 2011-2015, Marshall County has experienced the largest positive percent increase in the accommodation and food service sector and in retail trade. In contrast, the wholesale trade sector diminished by -31.88%.

STATS Indiana reported that 87.1% of the workforce in Marshall County was employed in the private sector. According to the Bureau of Labor Statistics, manufacturing, management of companies, and healthcare and social assistance remain the top earning sectors.

The 2015 estimated annual per capita income in Marshall County is \$36,958 compared to an Indiana average of \$41,940. The median household income is \$49,714 (1.6% lower than the state). The financial crisis has had a similar impact in Marshall County as it did in Indiana and the US, and in 2013, the county's unemployment rate was greater than both the state and the nation. This graph looks at the employment rate of the county population aged 16 years and over and illustrates how the county's unemployed population has changed over time compared to Indiana and the US. It also shows the percent of Marshall County's population below the poverty level.

Figure 3-6: County Population Unemployed and Below Poverty Level



The Marshall County Economic Development Corporation highlights the County's diverse employment industry, which includes everything from advanced manufacturing and distribution

to retail and logistics. The top major employers in terms of number of employees are listed by manufacturing and non-manufacturing.

Table 3-17: Top Manufacturing Employers

Company Name	Type of Business	Location	Employees
Southwire Co	Wire Products-Manufacturers	Bremen	600
Nishikawa Cooper Llc	Millwork	Bremen	450
Maax USA Corp	Plastics-raw/powder/resin-Manufacturers	Plymouth	350
Plymouth Precision Machine	Machine Shops	Plymouth	300
Bremen Castings	Foundries-steel	Bremen	225
L K Wood Products	Cabinets	Culver	197
Preqis	Floats-styrofoam	Plymouth	182
Del Monte Foods Inc	Food Products & Manufacturers	Plymouth	180
Bomarko Inc	Coated & Laminated Paper Nec	Plymouth	150
Bay Valley Foods Llc	Food Products & Manufacturers	Plymouth	142

Table 3-18: Top Non-Manufacturing Employers

Company Name	Type of Business	Location	Employees
Culver Academies	Schools	Culver	530
Walmart Supercenter	Department Stores	Plymouth	410
Universal Bearings Inc	Bearings (wholesale)	Bremen	280
United States Golf Academy	Golf Instruction	Plymouth	250
Valmont Site Pro 1	Telecommunication Equipment	Plymouth	250
Swan Lake Resort Golf Shop	Golf Equipment & Supplies-retail	Plymouth	250
St Joseph Regl Medical Center -Plymouth	Hospitals	Plymouth	243
Indiana Heat Transfer Corp	Radiators-automotive-wholesale	Plymouth	200
Catherine Kasper Life Ctr	Convents & Monasteries	Plymouth	200
Ancilla Domini Sisters	Convents & Monasteries	Plymouth	200

Education

The level of education of our workforce is a critical factor for economic and community development. It often provides insight into the skill levels of a local area. The type of work (occupations) residents perform can also assist in understanding skill levels. The following tables provide some more detail on the education attainment within the county over time and provide a comparison with the state averages.

Table 3-19: Educational Attainment Comparison over Time

	2000	Pct. of Pop. 25+	2015	Pct. of Pop. 25+
Less than 9th Grade	1760	0.062	2,104	6.8%
9th to 12th Grade, No Diploma	4013	0.141	2,677	8.7%
High School Graduate (incl. equivalency)	11724	0.411	12,496	40.5%
Some College, No Degree	5105	0.179	5,548	18%
Associate's Degree	1694	0.059	2,420	7.8%
Bachelor's Degree	2564	0.09	3,558	11.5%
Graduate or Professional Degree	1695	0.059	2,080	6.7%

Table 3-20: Educational Attainment

	2005	2006	2007	2008
Total Graduates	661	664	716	694
Total to Higher Education	530	550	567	547
Four-Year Institution	454	432	475	443
Two-Year Institution	42	65	50	62
Vocational/Tech.	34	53	42	42
Military	24	19	21	13

Table 3-21: High School Graduates Higher Education Intent

	2008 Pct. Dist.	Indiana Pct. Dist.
Graduates	100%	100%
Total Going on to Higher Education	78.8%	84.1%
Four-Year Institution	63.8%	61.2%
Two-Year Institution	8.9%	15.9%
Vocational and Tech.	6.1%	7%
Military	1.9%	2.6%

Culture

The development of the National Historic Preservation Act of 1966 initiated the federal fostering of the partnerships between the states, local governments, and the private sector on the preservation of our cultural resources. The Act established the National Register of Historic Places, composed of buildings, sites, structures, objects and districts significant in American history, architecture, archaeology, engineering and culture. The DNR Division of Historic Preservation & Archaeology (DHPA) is the state partner that manages the Indiana State Historic Architectural and Archaeological Research Database (SHAARD). Below the figures, display a variety of resources within the county identified within SHAARD. SHAARD is made possible by financial support from

the Federal Highway Administration, the Indiana Department of Natural Resources, and the Historic Preservation Fund of the U.S. Department of the Interior, National Park Service.

Historic and cultural resources are important because they are wonderful examples of architecture or engineering. Others are important for their connection to past people or events. Understanding what is important to the community can help develop better initiatives for project and strategies to accomplish the community's goals. Marshall County has 25 historic places, which appear on the National Register of Historic Places. There are eight established historic districts within the county. Of these historic districts, three are in Plymouth, two are in unincorporated Marshall County, one is in Argos, and two are in Culver. Another lengthy historic district area is shown stretched along the banks of Lake Maxinkuckee.

Table 3-22: Historic Places in Marshall County communities

City Of Plymouth	6
Marshall County (Unincorporated)	14
Town Of Bourbon	1
Town Of Bremen	3
Town Of Culver	1
Marshall County Total	25

The community of Plymouth possesses six of Marshall County's 25 recognized historic places: Hoham-Klinghammer-Weckerle House and Brewery Site, East Laporte Street Footbridge, Plymouth Fire Station, Hemminger Travel Lodge, Marshall County Courthouse, and Marshall County Jail. Marshall County's numerous historic structures are shown scattered liberally throughout the Historic Places Figure. For more information on the state historical county survey program, visit: <http://www.in.gov/dnr/historic/2824.htm>.

As part of the county cultural resources, Marshall County Museum and the Marshall County Historical Society are dedicated to helping preserve local history and heritage. The Marshall County Historical Museum was the recipient of 2014's Indiana Historical Society Award in recognition of the "remarkable public services and programs provided to its community." Believing that the past gives perspective on the present, the Marshall County Museum offers interactive exhibits and events on topics such as following historic highways that trace the story of Marshall County, walking the Trail of Death with Chief Menominee, and listening to World War II vets share their rich experiences.

Dotted throughout the county, Marshall County has 60 cemetery sites that serve as in memoriam to those that have past. The communities' religious sites, and cemeteries are shown on the cultural resources map.

Endowed with historic transportation structures, Marshall County contains 12 historic bridges. Six of the historic bridges are in Plymouth and six are in unincorporated Marshall County. Marshall County does not have any historic canal structures or canal segments.

Community Services & Infrastructure

The following section provides an overview on community services and infrastructure within Marshall County. Examples of community services include healthcare and public safety, while examples of community infrastructure include power utilities, water and sewer facilities, and the transportation network. The Critical Facilities Map identifies critical facilities for each community and a table of all critical facilities is provided in Appendix B.

Schools

Schools systems are valuable partners in Multi-Hazard Mitigation Planning because they can provide input in helping identify the risks from natural hazards to students, teachers, and school facilities. Communities proactively facilitate and support district policies, practices, and programs that help schools raise awareness and understanding of the potential impacts of hazards.

Marshall County is comprised of the Argos Community Schools, Bremen Public Schools, Culver Community Schools, Plymouth Community School Corporation, and Triton School Corporation. The county is also home to multiple private and alternative schools. The communities also possess a selection of private and parochial school options including Culver Academies, a boarding school.

In terms of post high school education, the Plymouth Community School Corporation provides students with the opportunity to receive vocational training and also offers adult education classes for return students. Located near Gilbert Lake, Ancilla Domini College is a two-year private liberal arts college that can prepare students to enter four year universities if they should so desire.

Recreation

Indiana has more than 21,000 miles of fishable streams and rivers, along with 452 natural lakes and 580 impoundments. The DNR manages the “Where to Fish” guide which includes an inventory of DNR-owned access areas, as well as other access sites where you can boat- or bank-fish. Dixon Lake, Koontz Lake, Lake of the Woods, Lake Maxinkuckee, Lake Lawrence, Mill Pond Lake, and Tippecanoe are all listed as DNR recommended fishing spots in Marshall County.

Throughout Marshall County, there are many campground facilities including Campers Roost Campground, Hidden Lake Paradise Campground, Lakeside Campground, Pla-Mor Camp Incorporated, Rupert's Resort, and Yogi Bear Jellystone Park. In addition, there are several rental cabins and RV campgrounds scattered around the county. The tables below outline the trails and managed lands within the communities. A map of the trails and recreational facilities is located in Appendix A.

In addition to hiking and fishing opportunities, Marshall County offers recreational sports and cultural forms of arts and entertainment. A table of Marshall County arts, entertainment, and recreation is available in Appendix B.

Table 3-23: Trail Status

	Open	Planned	Total
City of Plymouth	2	1	3
Marshall County (Unincorporated)	2	1	3
Town of Argos	3	-	3
Town of Bremen	2	-	2
Town of Culver	1	-	1
Marshall Total	10	2	12

Table 3-24: Managed Lands Type (acres)

	Federal	Local	Other	Private	State	Total
City of Plymouth	-	2	-	-	1	3
Marshall County (Unincorporated)	-	3	-	4	13	20
Town of Argos	-	2	-	-	-	2
Town of Bremen	-	1	-	-	-	1
Town of Culver	-	1	-	-	-	1
Total	0	9	0	4	14	27

Public Facilities

Public facilities buildings, properties, and other areas are government or community owned, operated or funded and are central to government operations and activities. Public facilities are vital for sustaining and providing the members of the community with public services related to safety, health, and wellbeing. Supporting and working with public facilities, Marshall County has eleven social service and welfare organizations that supplement public aid. The county has several senior citizen service organizations and youth centers that provide help create opportunities for community engagement. Aiding communication and outreach, seven post offices service Marshall County.

Supporting public literacy and community engagement, Marshall County boasts four libraries: Bremen Public Library, Bourbon Library, Argos Public Library, and Plymouth Public Library. Appendix B provides an extensive list of the public facilities within the county.

Public Utilities

Water and Wastewater

Surface water is the primary source of water in Marshall County. Other towns and residences obtain groundwater from individual wells. Marshall County has a sum total of 2,813,996 artificial paths, canal ditches, connectors, and Stream Rivers winding through the county, transporting and supplying water.

There are three types of wastewater treatment systems in Marshall County, including public sewer systems operated by municipalities and sanitary districts, community systems operated by homeowner associations, and individual sewage treatment systems. Water service in Marshall County is provided by municipalities, water districts, private water associations, and individual wells. Plymouth Water Department, Argos Light & Water Plant, Bremen Waste Water Treatment, Culver Wastewater Plant, and Marshall County Soil & Water help provide water supply and waste disposal needs for the county.

Other Utilities

Among its other utilities and public facilities, Marshall County contains a solid waste and recycle depot that handles both recycling and household hazardous waste disposal. Hazmat facilities seek to provide a point of control, management, and tracking of hazardous materials. Hazardous material transportation adheres to strict requirements, but in the case of a disaster, it is beneficial

for planners and responders to be aware of the locations and transportation routes of hazardous materials particularly those near or in population centers.

Health Care Providers

An emergency disaster can impact an entire community and can involve numerous medical and public health entities, including health care provider systems, public health departments, emergency medical services, medical laboratories, individual health practitioners, and medical support services. A coordinated response is essential for effective emergency management, so being aware of the locations and resources of healthcare providers is important to preparing for and responding to disasters. Vulnerable populations such as people within nursing homes and hospitals frequently require a unique response during a disaster and could be at considerable risk if their care was disrupted.

The St. Joseph Regional Medical Center in Plymouth is one of the county's key healthcare resources and one of Marshall's larger non-manufacturing employers. Other hospitals include the Community Hospital of Bremen, Doctors Neuromedical Hospital, Doctors Neuropsychiatric Hospital, and Michiana Behavioral Health Center. Marshall also contains multiple health and welfare agencies, healthcare facilities, and health services. For planning mitigation and emergency evacuation purposes, it is also important for community leaders to be aware of the locations of retirement communities and nursing and convalescent homes. Health care and social assistance providers are listed in Appendix B.

The Marshall County Health Department's mission states, "The Marshall County Health Department, in serving the people of Marshall County, helps protect and avoid potentially dangerous threats to the health, safety and welfare of the community." In order to better enable it to meet the challenges of public health issues on a daily basis, The Marshall County Health Department has balanced itself to provide services ranging from the following categories Bats, Bedbugs, Birth/Death Records, Ebola Virus, Enterovirus D68, Food Service Permits, Immunizations, Meth, Public Health Nuisance Complaints, Septic Permit, Shot Clinic, Water Testing, and Zika Virus.

Public Safety Providers/Government Services

The Marshall County Sheriff's Department is centrally located in the city of Plymouth. The county sheriff is the chief law enforcement officer in the county, but the Indiana State Police does

maintain a department in Bremen. Dedicated to community safety, Marshall County has five fire departments and four police departments. The Communities of Argos, Bourbon, Bremen, Culver, and Plymouth each support their own police department.

The community fire departments consist of Bourbon Fire Department, Bremen Community Fire Department, La Paz-north Township Plymouth Fire Department, and Tippecanoe Fire Department. Additionally, Polk Township Volunteer Fire Department- Tyner, Polk Township Volunteer Fire Department- Walkerton, and La Paz North Township Volunteer Fire Department work to fight fire hazards in the county.

Appendix B depicts government and emergency facilities, which includes city halls, fire departments, police departments, sheriff's department, and the Marshall County Courthouse.

Utilities/Communications

Utilities are vulnerable to a variety of hazards including natural disasters like tornadoes, earthquakes, flooding, wildfires, and storms. The impacts from hazards can damage utility equipment and cause disruptions of services and the loss of power, water, communication, and revenue. According to the Environmental Protection Agency, communities can mitigate damage to utilities before a disaster occurs by implementing projects to “better withstand a natural disaster, minimize damage, and rapidly recover from disruptions to service.” While mitigating utilities frequently requires financial investment, mitigation could improve more costly future damage, improve the reliability of service during a disaster, and help people keep the amenities they desperately require.

During a disaster, communications and emergency management seem to become synonymous, and reliable communication can become one of the highest assets during a disaster. Communication is both one of the key elements to secure an effective disaster response as well as one of the most difficult elements to insure. The U.S. Department of Homeland Security reports that the Communications Sector provides an “enabling function” across all critical infrastructure sectors. The communications sector is closely linked to other sectors including the energy, information technology, financial services, transportation systems, and emergency services.

Located in Plymouth, Marshall County REMC is the electric cooperative providing electricity services to the residents of the county. Although the REMC primarily serves Marshall County, it also is the electric service provider for portions of St. Joseph, Elkhart, Kosciusko, Fulton

and Starke Counties. Marshall County REMC's affiliates include Wabash Valley Power, Indiana Electric Cooperatives, Touchstone Energy, and America's Electric Cooperatives. The principal gas company serving the county is Ni Source Gas Company.

Appendix B offers an overview of Marshall County utilities including power substations, electric transmission lines, and FM/AM radio towers.

Marshall County is a StormReady community which is a program administered by the National Weather Service. The StormReady program helps arm America's communities with the communication and safety skills needed to save lives and property--before, during and after the event. StormReady helps community leaders and emergency managers strengthen local safety programs.

To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive severe weather warnings and forecasts and to alert the public
- Create a system that monitors weather conditions locally
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Transportation

Roads and Bridges

The county transportation system is composed of roads, highways, airports, public transit, railroads and trails, designed to serve all residents, businesses, industries and tourists. The Indiana Department of Transportation (INDOT) LaPorte District manages the county state transportation resources. The transportation features include county, state, and local (city) bridges, active and abandoned railroads, and the air, bus, or rail facilities within the county. The breakdown of the quantity and type of roads are presented in the transportation features table.

Table 3-25: Marshall County Transportation Features

	Bridges	Roads (mi)
State	49	
US Route		142
State		158
County	109	920
Local	8	124
Other	4	
Proposed		9
State Managed Land		<1
Total	170	1,352

There are no federally managed roads in the county. All county bridges are the responsibility of the County Engineer at the Marshall County Highway Department. Refer to the transportation features map located in Appendix A, which further detail the transportation features and facilities in the county and highlighted below.

Rail

Marshall County has four rail corridors: CSX, Chicago, Fort Wayne & Eastern Railroad (CFER), CSX and Norfolk Southern (NS), and Elkhart & Western Railroad and Fulton County Railroad (EWR). CSX and Norfolk Southern (NS) operates over 42,000 miles of track throughout 20 states east of the Mississippi River and into Canada. Passing adjacent to the Bremen Industrial Park, one of the largest industrial parks in the county, CSX is a freight railroad running from the northern part of the county to Chicago. The Chicago, Fort Wayne & Eastern Railroad (CFER) crosses through the south part of the City of Plymouth and the Town of Bourbon.

Air

The largest commercial airport is Plymouth Municipal Airport. Thirteen airports in the county provide private air service. The closest international airport is the South Bend International Airport, and it located just 20 miles north of the county seat of Plymouth. International air transportation is also available at the Chicago O'Hare International Airport and the Chicago Midway International Airport which are located within a couple hours' drive of Plymouth.

Seaports

Marshall County does not have its own port, but the Port of Indiana - Burns Harbor is located on the south shore of Lake Michigan an hour away from Marshall to the northwest. The port acts as a

gateway to the Midwest for international shippers. Inland rivers link the port to 38 states and the Gulf of Mexico.

Commute

County-to-county commuting patterns provide a gauge of the economical connectivity of neighboring communities. The US Census reports that over 27% of US workers travel outside their residential county to travel to work.

According to Stats Indiana 2014 data, there are 31,334 people who live in Marshall County and work (implied resident labor force). Of these residents, 5,860 (18.7%) work outside the county. An additional 4,929 people living in other counties commute to Marshall County for work.

The mean travel time to work in Marshall County is 21.3 minutes compared to a 25-minute average in the US. Commuter safety is an important consideration in disaster mitigation and planning. Employers can help their employees prepare by encouraging the development of Commuter Emergency Plans, such as the template developed by FEMA and available for download at <http://www.fema.gov/media-library/assets/documents/90370>.

Table 3-26: Commuting Patterns: Top five counties sending workers INTO county, 2015

County	Number	Pct. Five County Total
Starke County	1,529	37.8%
St Joseph County	1,231	30.4%
Fulton County	565	14%
Kosciusko County	420	10.4%
Elkhart County	300	7.4%

Table 3-27: Commuting Patterns: Top five counties receiving workers FROM county, 2015

County	Number	Pct. Five County Total
St Joseph County	2,131	42.1%
Elkhart County	1,527	30.1%
Kosciusko County	986	19.5%
Starke County	212	4.2%
Fulton County	210	4.1%

Hoosiers by the Numbers: Indiana County Highlights captured the U.S. Census Bureau & American Community Survey 5 Year Estimates that the majority (91.1%) of Marshall County residents traveling to work in 2015 went by car, truck, or van, and, of those who traveled via car, truck or van,

79.7% traveled alone. Only 0.2% of residents traveling to work relied on public transportation, and 5.6% used some other conveyance, such as motorcycle, bicycle, or walking.

Chapter 4 – Risk Assessment

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, property damage, disruption to local and regional economies, and the expenditure of public and private funds for recovery. Sound mitigation practices must be based on sound risk assessment. A risk assessment involves quantifying the potential loss resulting from a disaster by assessing the vulnerability of buildings, infrastructure, and people.

Developing a priority on the hazards the community is exposed to is one of the first priorities before conducting a risk assessment. The following section will then include the descriptions of hazard, history, vulnerability & future development, relationship to other hazards, plans & programs in place and gaps & deficiencies. This risk assessment identifies the characteristics and potential consequences of a disaster, how much of the community would be affected by a disaster, and the impact on community assets.

Basing risk assessments on the best information available is important in developing effective mitigation actions that benefit communities. Geographic Information System (GIS) tools are not only helpful in producing maps, but they also show structures at risk and may determine damage estimates for potential hazard scenarios. FEMA created Hazards USA Multi-Hazard (Hazus-MH), a powerful GIS-based disaster risk assessment tool. This tool enables communities to predict estimated losses from floods, hurricanes and other related phenomena and to measure the impact of various mitigation practices that might help reduce those losses.

Assessing Hazards

The term “natural hazards” refers to those forces extraneous to man in elements of the natural environment. They are not possible to manage, and are often interrelated. Natural hazards do not always cause damage to humans or the built environment; until a hazard and development intersect, significant damage can occur creating the natural disaster.

The term “technological hazards” refers to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. They can also be intentional or the result from an emergency cause by another hazard (e.g., flood,

storm). In addition, technological hazards, such as hazmat incidents and levee failures, provide the county the ability to quantifiable measure the potential results of an incident, and therefore were included in depth in this plan. To capture the potential effects of these technological hazards within natural disasters, this plan identifies all technological hazards within one portion of a hazard profile.

Finally, “human cause” or “adversarial” disaster are intentional or by accident. The term “terrorism” refers to intentional, criminal, and malicious acts. There is no single, universally accepted definition of terrorism, and it can be interpreted in many ways. For the purposes of this plan, FEMA refers to “terrorism” as the use of Weapons of Mass Destruction (WMD), including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and “cyber terrorism.”

Hazard Identification/Profile

Hazard Identification

The US Department of Homeland Security developed the Threat and Hazard Identification and Risk Assessment Guide, Comprehensive Preparedness Guide (CPG) 201 which was used as a guide for the hazard identification and profile development. The process of developing a THIRA helps communities identify capability targets and resource requirements necessary to address anticipated and unanticipated risks. The FEMA Preparedness Types of Threats or Hazards table provides example of each type of threat or hazard.

The cornerstone of the risk assessment is identification of hazards that affect the county and each jurisdiction. To facilitate the planning process, several sources were employed to ensure that natural hazards are identified prior to assessment.

In the FEMA publication “Comprehensive Preparedness Guide for Developing Emergency Operation Plans,” FEMA defines hazards as natural, technological or human caused.

Table 4-1: FEMA Preparedness Types of Threats or Hazards

Natural	Technological	Human-caused
Animal disease outbreak	Airplane crash	Biological attack
Drought	Dam failure	Chemical attack
Earthquake	Levee failure	Cyber attack
Epidemic	Mine accident	Explosives attack
Flood	Hazardous materials release	Radiological attack
Landslide	Power failure	Sabotage
Pandemic	Radiological release	School or workplace violence
Tornado	Train derailment	
Wildfire	Urban conflagration	
Winter storm		

WebEOC is the State of Indiana's crisis information management system, which is the communications platform for local, county and state emergency managers/homeland security partners. Partners in emergency management personnel at the local, county and state level which is where the comprehensive list of the 31 core five preparedness mission areas (prevention, protection, mitigation, response, recovery) and 31 core capabilities participated. Based on the FEMA hazards, the state identified the following specific concerns in the 2014 Indiana State Hazard Mitigation Plan.

Table 4-2: State Hazard Mitigation Plan Identified Threats or Hazards

Natural	Technological	Human-caused
Animal disease outbreak	Airplane crash	Biological attack
Drought	Dam failure	Chemical attack
Floods	Communication System Failure	Cyber Attack
Severe Thunderstorm and Tornado	Hazardous Materials Release	Active Shooter
Earthquakes	Public Utility Failure	Arson
Winter Storms	Air Transportation Incidents	CBRNE Attack
Drought	Explosion	Hostage Situation
Extreme Temperatures	Dam/Levee Failure	Riot
Wild Fire	Structural Fire	Terrorism
Disease Outbreak	Ground Failure (Subsidence)	
Fluvial Erosion		

The primary focus of this mitigation plan will be on the development of strategies analysis related to those natural and technological hazards that are managed or affect the city, town county communities. The following sections define the natural and technological that are recognized with analysis and strategies in this plan.

Natural Hazards – Presented by the Physical World

Those forces extraneous to man in elements of the natural environment, are difficult to manage, and are often interrelated. Natural hazards do not always cause damage to humans or the built environment; until a hazard and development intersect, significant damage can occur creating the natural disaster. In general, there are three types of natural hazards, geologic, atmospheric, and other natural hazards that will be covered in this plan:

Table 4-3: Natural Hazards Identified in Plan

Geologic	Atmospheric	Other
Flooding	Droughts	Infectious Disease Outbreak
Flash Flooding	Extreme Temperatures	Wild Fires
Ground Failure <ul style="list-style-type: none">• Mine• Fluvial erosion• Karst areas	Summer Storms <ul style="list-style-type: none">• Thunderstorms• Hail• Lightning• Wind	
Earthquakes	Tornadoes	
	Winter storms	

Technological Hazards – Presented by Man

Technological hazards and human caused hazards are distinct from natural hazards primarily in that they originate from human activity. In contrast, while the risks presented by natural hazards may be increased or decreased as a result of human activity, they are not inherently human-induced. Technological hazards can be incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. These hazards can also be intentional or the result from an emergency cause by another hazard (e.g., Flood, Storm). The following table provides a summary of the technological hazards covered in depth in this plan.

Table 4-4: Technological Hazards Identified in Plan

Technological		
Dam failure	Hazardous Material Release	Levee failure

Calculated Priority Risk Index

The Calculated Priority Rating Index (CPRI) is a process that evaluates the probability, consequence, warning time and duration in order to develop a hazard rank. A comprehensive list of all three classifications and ungrouped hazards are maintained with WebEOC. The also committee drew on the natural probability and impact ranked in the previous plan and more

recent THIRA assessments when determining the final rank. The team reviewed previous plans hazard priority as shown in the following table.

Table 4-5: Hazards rank in previous Multi-Hazard Mitigation Plan

Hazard
Flooding
Tornado
Thunderstorms / High Winds / Hail
Hazardous Materials Release
Drought / Extreme Heat
Earthquake
Severe Winter Storms

Through the completion of a hazard risk and probability survey and discussion in meeting two, the team developed a consensus on the hazard priority for the county for the purposes of this plan. The team determined the ranking considering the natural and technological hazards outlined in the following table.

Table 4-6: Calculated Priority Risk Index for the County

Natural Hazards	Probability	Consequence	Warning Time	Duration	Risk Factor
Winter Storms	4 - Highly Likely	3 - Critical	3 - 6-12 Hours	3 - < 1 Week	3.45
Tornadoes	4 - Highly Likely	3 - Critical	4 - < 6 Hours	1 - < 6 Hours	3.4
Summer Storms	4 - Highly Likely	3 - Critical	4 - < 6 Hours	1 - < 6 Hours	3.4
Infectious Outbreak	3 - Likely	3 - Critical	4 - < 6 Hours	2 - < 24 hours	3.05
Hazardous Incident	3 - Likely	3 - Critical	4 - < 6 Hours	2 - < 24 hours	3.05
Flash Flooding	3 - Likely	3 - Critical	3 - 6-12 Hours	3 - < 1 Week	3
Wild Fires	3 - Likely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	2.75
Earthquake	2 - Possible	3 - Critical	4 - < 6 Hours	2 - < 24 hours	2.6
Extreme Temperatures	3 - Likely	2 - Limited	1 - 24+ Hours	4 - > 1 Week	2.5
Drought	2 - Possible	3 - Critical	1 - 24+ Hours	4 - > 1 Week	2.35
Flooding	2 - Possible	2 - Limited	1 - 24+ Hours	4 - > 1 Week	2.05
Ground Failure	1 - Unlikely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	1.85
Dam Failure	1 - Unlikely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	1.85
Levee Failure	1 - Unlikely	2 - Limited	4 - < 6 Hours	2 - < 24 hours	1.85

The following formula provides the weighted factors described in the table and detailed below.

$$\text{Risk Factor} = [(Probability/.45) \times (Consequence/.30) \times (Warning\ Time/.15) \times (Duration/.10)]$$

Table 4-7: Summary of Calculated Priority Risk Index (CPRI) Categories and Risk Levels

CPRI Category	DEGREE OF RISK			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	Extremely rare with no documented history of occurrences or events. Annual probability of less than 0.001	1	45%
	Possible	Rare occurrences with at least one documented or anecdotal historic event. Annual probability that is between 0.01 and 0.001.	2	
	Likely	Occasional occurrences with at least two or more documented historic events. Annual probability that is between 0.1 and 0.01.	3	
	Highly Likely	Frequent events with a well-documented history of occurrence. Annual probability that is greater than 0.1.	4	
Consequence	Negligible	Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). Injuries or illnesses are treatable with first aid and there are no deaths. Negligible quality of life lost. Shutdown of critical facilities for less than 24 hours.	1	30%
	Limited	Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). Injuries or illnesses do not result in permanent disability and there are no deaths. Moderate quality of life lost. Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and at least one death. Shut down of critical facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and multiple deaths. Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours		4	15%
	6 to 12 hours		3	
	12 to 24 hours		2	
	More than 24 hours		1	
Duration	Less than 6 hours		1	10%
	Less than 24 hours		2	
	Less than one week		3	
	More than one week		4	

- **Probability** – a guide to predict how often a random event will occur. Annual probabilities are expressed between 0.001 or less (low) up to 1 (high). An annual probability of 1 predicts that a natural hazard will occur at least once per year.
- **Consequence/Impact** – indicates the impact to a community through potential fatalities, injuries, property losses, and/or losses of services. The vulnerability assessment gives information that is helpful in making this determination for each community.
- **Warning Time** – plays a factor in the ability to prepare for a potential disaster and to warn the public. The assumption is that more warning time allows for more emergency preparations and public information.
- **Duration** – relates to the span of time local, state, and/or federal assistance will be necessary to prepare, respond, and recover from a potential disaster event.

Hazard Risk Assessment by Jurisdiction

The risk assessments identify the characteristics and potential consequences of a disaster, how much of the community could be affected by a disaster, and the impact on community assets. While some hazards are widespread and will impact communities similarly, e.g. winter storms, others are localized leaving certain communities at greater risk than others, flash flooding and sewer related problems, exposure to a particular high-risk dam. The following diagrams illustrate each community's risk to flooding, dam/levee failure, hazardous materials incidents, and ground failure and are highlighted within the risk assessment.

Table 4-8: Localized Hazards for Incorporated Jurisdictions

Jurisdictions	Hazard Probability			
	Flooding	Dam/Levee	Hazardous Release	Ground Failure
Argos	Highly Likely	Possible	Likely	Possible
Bourbon	Possible	Possible	Likely	Possible
Bremen	Possible	Possible	Likely	Possible
Culver	Possible	Possible	Likely	Possible
La Paz	Possible	Possible	Likely	Possible
Plymouth	Highly Likely	Possible	Possible	Possible

NCDC Historical Storm Events

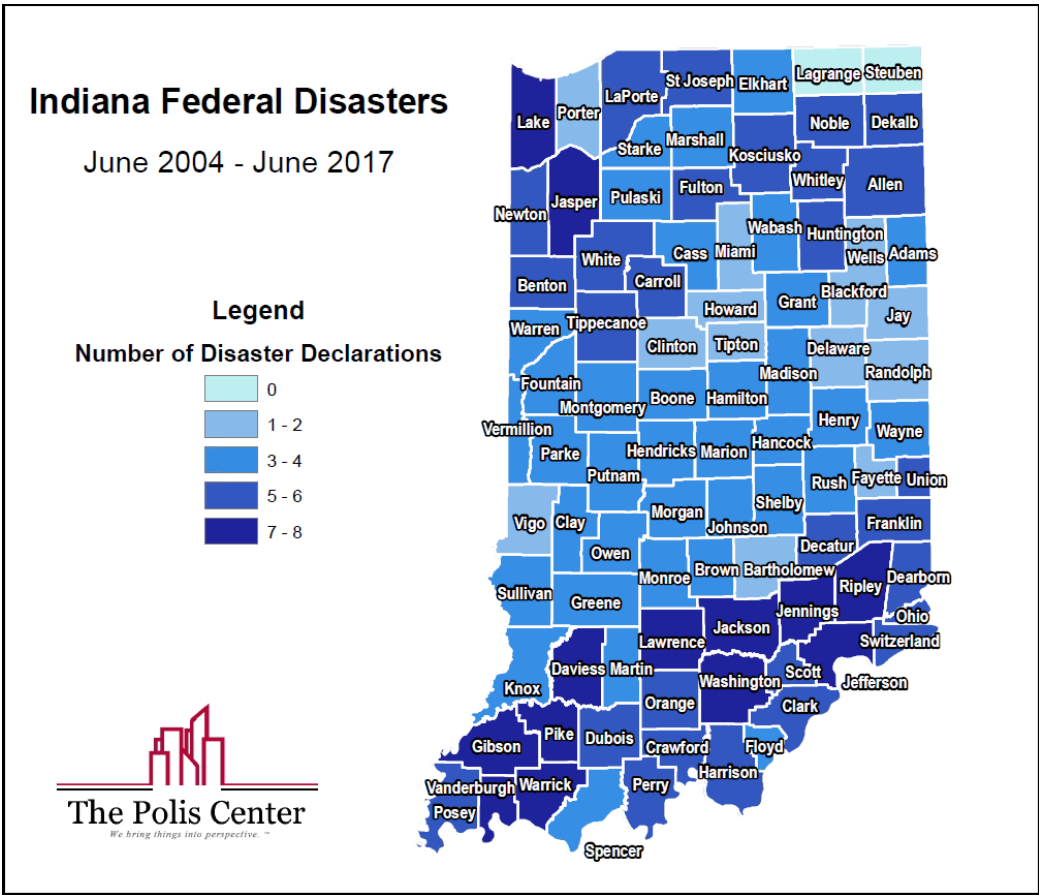
Historical storm event data was compiled from the National Climatic Data Center (NCDC). NCDC records are estimates of damage reported to the National Weather Service (NWS) from various local, state, and federal sources. Typically, the submissions are from law enforcement and emergency managers. It should be noted these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to given weather events.

The NCDC data included 275 reported events in Marshall County between 1965 and December 31, 2016. Including; 183 summer storms, 18 tornado events, 8 flood events, 63 winter storms, 3 extreme temperature events. A table listing all events, including; injury, death, and property loss statistics are included in Appendix C.

FEMA Declared Disasters

Since 2004, FEMA has declared 17 emergencies and disasters for the state of Indiana. The following map shows the number of disasters by county in the state since June 2004.

Figure 4-1: Disaster Declarations for Indiana



The FEMA-Declared Disasters and Emergencies for Marshall County (2000- 2017) table shows the details of the major disaster declarations including FEMA hazard mitigation funding and total assistance for Marshall County. Marshall County has received federal aid for three declared disasters and three emergencies since 2000.

Table 4-9: FEMA-Declared Disasters and Emergencies for Marshall County (2000- 2017) ¹⁸

Disaster Number	Date of Incident	Date of Declaration	Disaster Description	Type of Assistance
EM-3162	12/11/2000-12/31/2000	1/24/2001	Indiana Severe Winter Storms	PA
DR-1573	1/1/2005-2/11/2005	1/21/2005	Indiana Severe Winter Storms and Flooding	IA, HMGP
EM-3238	8/29/2005-10/1/2005	9/10/2005	Indiana Hurricane Evacuation	PA
EM-3274	2/12/2007-2/14/2007	3/12/2007	Indiana Snow	PA
DR-1740	1/7/2008- 3/14/2008	1/30/2008	Severe Winter Storms and Flooding	IA, PA, HMGP
DR-1832	3/8/2009-3/14/2009	4/22/2009	Severe Storms, Tornadoes and Flooding	IA, HMGP

PA – Public Assistance Program - IA – Individual Assistance Program - HMGP – Hazard Mitigation Grant Program

In the event of a federally declared disaster, individuals, families, and businesses may apply for financial assistance to help with critical expenses. Assistance may be categorized as Individual Assistance (IA), Public Assistance (PA), or Hazard Mitigation Assistance (HMA). The following types of assistance may be available in the event of a disaster declaration:

Individuals & Household Program: Provides money and services to people in presidentially declared disaster areas.

Housing Assistance: Provides assistance for disaster-related housing needs.

Other Needs Assistance: Provides assistance for other disaster-related needs such as furnishings, transportation, and medical expenses.

Public Assistance: Disaster grant assistance available for communities to quickly respond to and recover from major disasters or emergencies declared by the president.

Emergency Work (Categories A-B): Work that must be performed to reduce or eliminate an immediate threat to life, to protect public health and safety, and to protect improved property that is significantly threatened due to disasters or emergencies declared by the president.

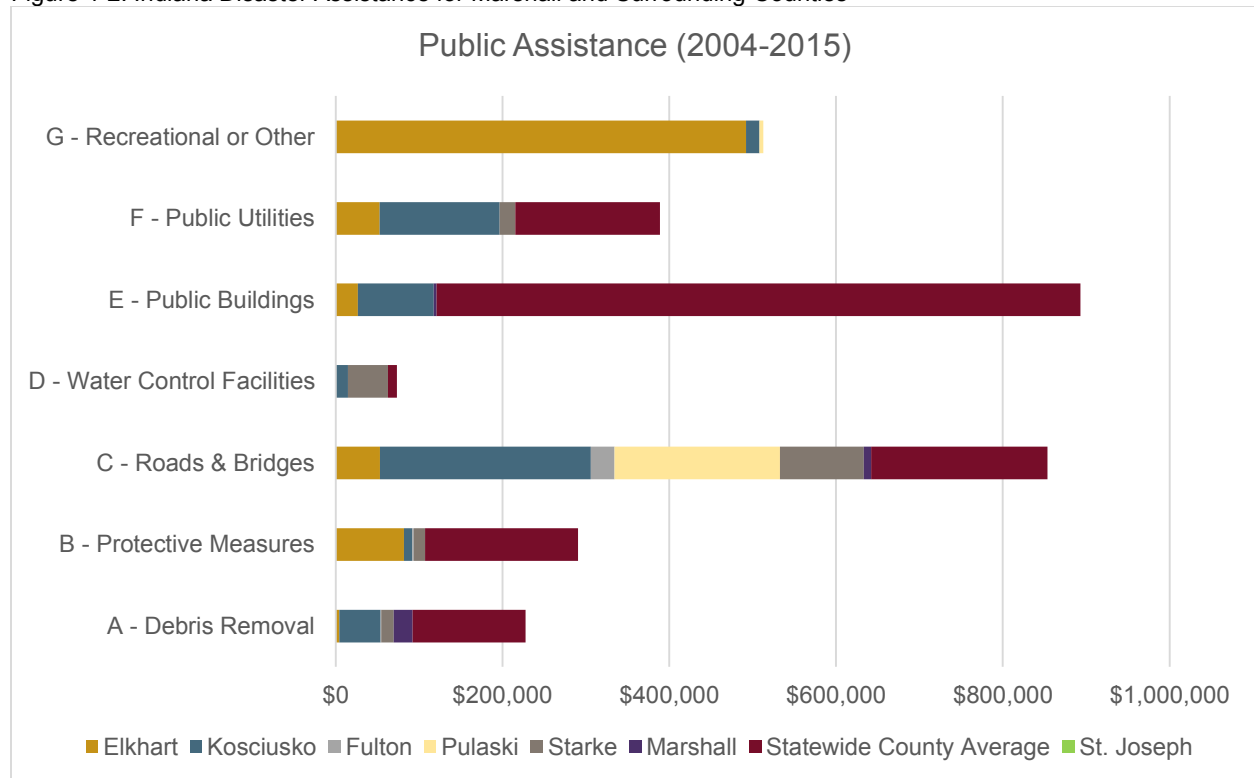
Permanent Work (Categories C-G): Work that is required to restore a damaged facility, through repair or restoration, to its pre-disaster design, function, and capacity in accordance with applicable codes and standards.

¹⁸ Disaster declarations with multiple hazards may be regional and all hazards may not impact every community/county in the declaration.

Hazard Mitigation Assistance: Provides assistance to states and local governments through the Hazard Mitigation Grant Program (HMGP) to implement long-term hazard mitigation measures after a major disaster declaration.

Highway departments claimed significant damages from flooding and fluvial erosion, and rural electrical cooperatives have historically been vulnerable to ice storms and high winds. Below the figure identifies the category funding that has happened in the county and surrounding counties. Figure 4-2 provides a breakdown of the PA in comparison to surrounding counties and the statewide averages.

Figure 4-2: Indiana Disaster Assistance for Marshall and Surrounding Counties



Other Disaster Relief

In 2006, Indiana began appropriating funds to its State Disaster Relief Fund (SDRF) from the revenues it generated from firework sales to ensure the availability of a dedicated source of disaster funding. Through this program the state provides both public and individual assistance. The state established the disaster relief fund in 1999, it did not appropriate funds to the account due to fiscal constraints. In 2006, the state began dedicating funds from the sale of fireworks. Then

in 2007, the state established in statute that the fund would receive an annual appropriation of \$500,000 from revenues generated from the firework sales.

In addition to potential state funding, homeowners and businesses can be eligible for low-interest and long-term loans through the U.S. Small Business Administration (SBA). SBA was created in 1953 as an independent agency of the federal government to aid, counsel, assist and protect the interests of small business concerns. The program also provides low-interest, long-term disaster loans to businesses of all sizes, private nonprofit organizations, homeowners and renters following a declared disaster. The loans can also provide resources for Homeowner Associations, Planned Unit Developments, co-ops, condominium and other common interest developments. SBA disaster loans can be used to repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets.

Through the disaster loan program, SBA provides the on loan data, including; FEMA and SBA disaster numbers, type (business or home), year, and various reporting amounts on the verified and approved amount of real estate and contents. Below, Figure 4-3 identifies the total verified loss by community, loan type, and year of event. Table 4-10 provides a breakdown of the number of claims per year and its relationship to the SBA declaration and FEMA disaster number, if applicable.

Figure 4-3: Community Total Reported Damage

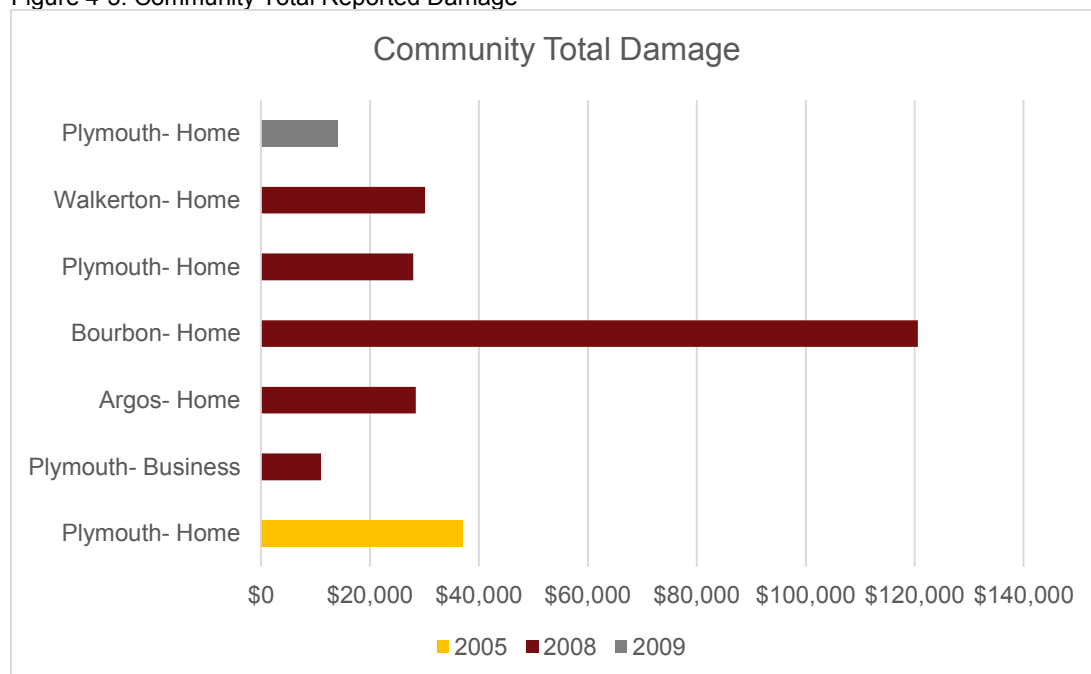


Table 4-10: SBA declaration reference

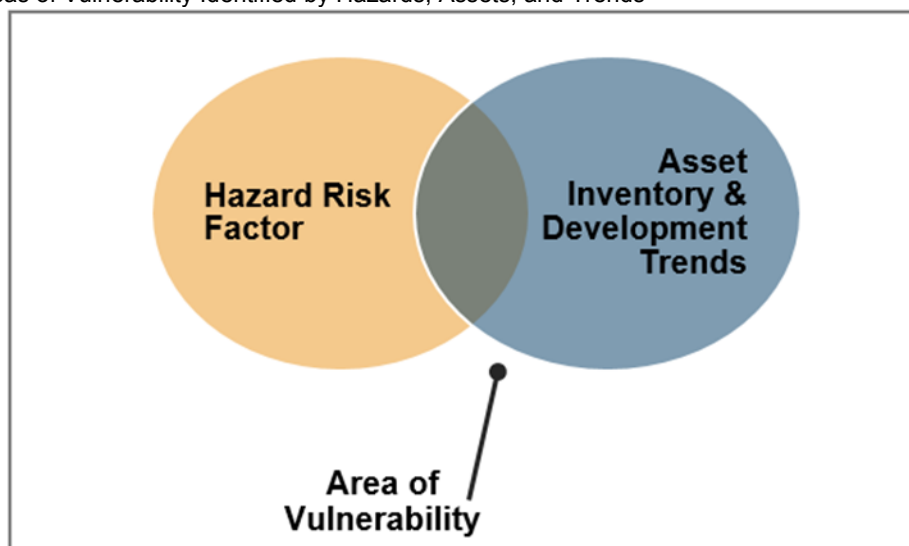
Year	FEMA Declaration	SBA Declaration	Community
2005	1573	10007	Plymouth
2008	n/a	11146	Bourbon
2008	1740	11160	Argos
2008	1740	11160	Plymouth
2008	1740	11160	Walkerton
2009	1832	11720	Plymouth
2005	1573	10007	Plymouth

Vulnerability Assessment

Asset Inventory

The vulnerability assessment builds upon the previously developed hazard information by identifying the community assets and development trends. Determining the hazard rank is pertinent to determining the area of vulnerability, as displayed in the following figure. The county infrastructure and facilities inventory are a critical part of understanding the vulnerability at risk of exposure to a hazard event.

Figure 4-4: Areas of Vulnerability Identified by Hazards, Assets, and Trends



The assets presented in the analysis results are a hybrid of the essential facilities updated by the county and the building inventory developed from the local assessor data. The facility features used the Department of Homeland Security in the Automated Critical Asset Management System (ACAMS) for guidance. Of the approximately 15 essential facilities, five are essential: schools, police and fire stations, emergency operation center (s) and medical facilities. For the purposes for

this analysis, medical facilities are a combination of numerous medical related layers (hospitals, long-term care/nursing homes, pharmacy, etc.) and are referred to in this analysis as Care Facilities. The remaining structures are related to the communities' infrastructure and utility management.

The local assessor parcel submitted to the Indiana Department of Local Government and Finance (IDLGF) are used to generate the data referred to as the Building Inventory. This data is classified as agricultural, commercial, education, government, industrial, religious/non-profit, and residential properties. The local assessor parcel submitted to the Indiana Department of Local Government and Finance (IDLGF) are used to generate the data referred to as the Building Inventory. This data is classified as agricultural, commercial, education, government, industrial, religious/non-profit, and residential properties. Parcels with improvements are used to inform the exposure analysis and are the source the structures, value, various attributes on the structures construction. Details on the steps of the building inventory development and maps on parcel attributes and facilities used in the overlay analysis are detailed in Appendix C.

Figure 4-5: Essential Facilities in Marshall County

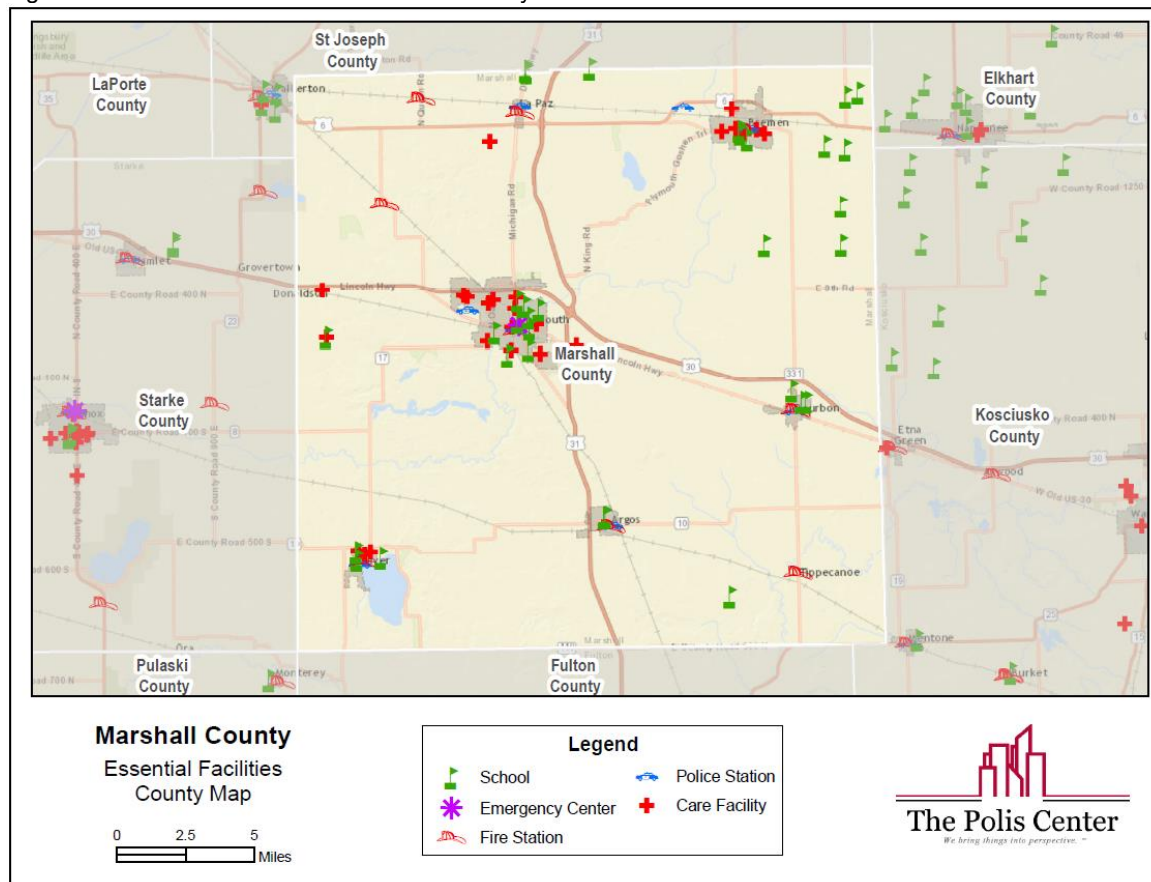
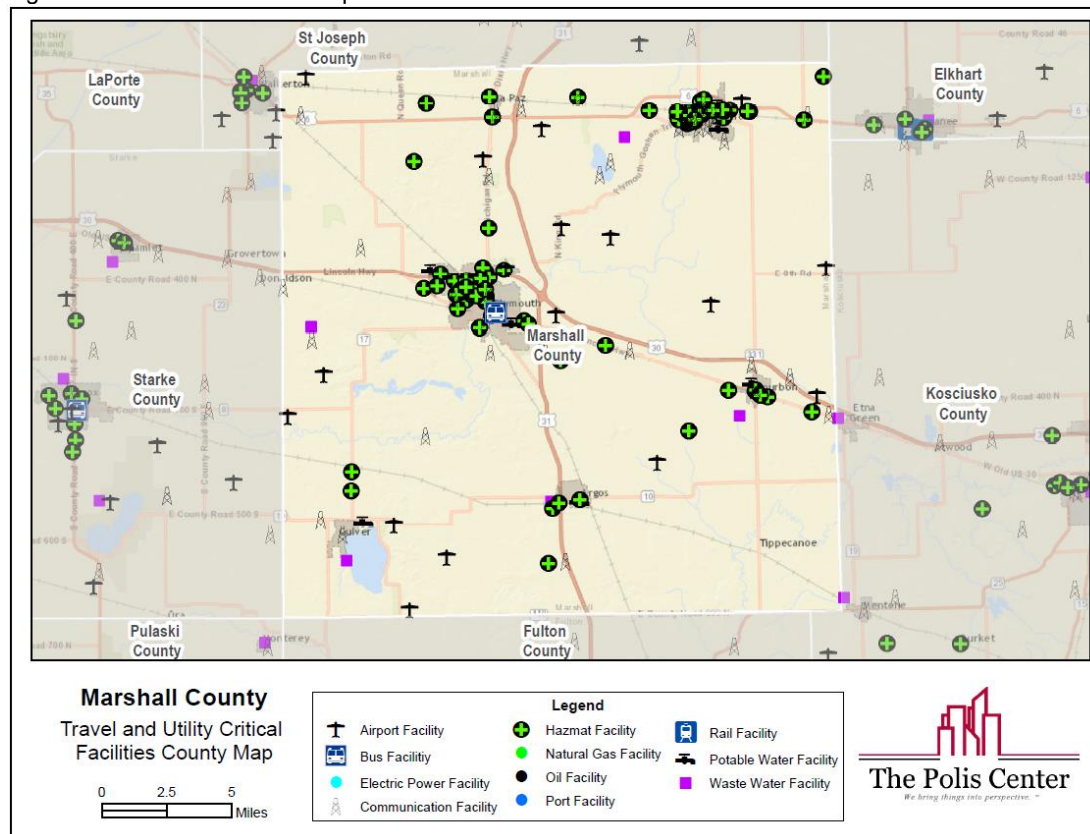


Figure 4-6: Critical Facilities Map



Facility Replacement Costs

Hazus-MH MR4 contains the base aggregated general building stock used for estimating building exposure. Hazus-MH MR4 contains aggregated general building stock updated to Dun & Bradstreet in 2014 and building valuations were updated to R.S. Means 2014. Building counts based on census housing unit counts are available for RES1 (single-family dwellings) and RES2 (manufactured housing) classifications instead of actual building counts. The total building exposure for Marshall County is identified in Table 4-11 along with the estimated number of buildings within each occupancy class. These counts and costs were derived from the county assessor and parcel data, versus the default Hazus general building stock. Exposure refers to the cost to rebuild the structure given the inputs of features such as foundation type, year, and condition. Details on the process to develop this data is provided in Appendix D.

Table 4-11: Marshall County Total Building Exposure

Occupancy Type	Estimated Total Buildings	Total Building Exposure (\$)
Agricultural	13,469	\$3,843,817,153
Commercial	7,616	\$16,685,655,995
Education	260	\$2,633,738,343
Government	1,161	\$2,444,670,066
Industrial	1,006	\$9,568,693,214
Religious/Non-Profit	1,927	\$6,194,741,335
Residential	121,313	\$30,778,451,510
Total	146,752	\$72,149,767,616

GIS and Hazus-MH

FEMA's Pre-Disaster Mitigation (PDM) program is designed to provide assistance to local communities to develop and implement their hazard mitigation plan, thereby reducing risk to property and lives. The initial multi-hazard mitigation plan (MHMP) for Marshall County, Indiana was submitted to FEMA and approved in 2009. Existing Hazus-MH technology was used in the development of the vulnerability assessment for flooding and earthquakes. With the implementation of new technology and locally available parcel datasets, more accurate results are now available. Multi-hazard mitigation plan updates may document significant variances from the original MHMP.

For this analysis, Hazus-MH generated a combination of site-specific (flood) and aggregated loss (earthquake) estimates. Aggregate inventory loss estimates, which include building stock analysis, are based upon the assumption that building stock is evenly distributed across census blocks/tracts. With this in mind, total losses tend to be more reliable over larger geographic areas than for individual census blocks/tracts. Site-specific analysis based upon loss estimations for individual structures. For flooding, analysis of site-specific structures takes into account the depth of water in relation to the structure. Hazus-MH also takes into account the actual dollar exposure to the structure for the costs of building reconstruction, content, and inventory. Damages are based upon the assumption that each structure will fall into a structural class, and structures in each class will respond in a similar fashion to a specific depth of flooding. Site-specific analysis also is based upon a point location rather than a polygon; the model does not account for the percentage of a building that is inundated.

It is important to note that Hazus-MH does not a substitute for detailed engineering studies. Rather, it serves as a planning aid for communities interested in assessing their risk to flood,

earthquake, and hurricane-related hazards. This documentation does not provide full details on the processes and procedures completed in the development of this project.

Site-specific analysis is based upon loss estimations for individual structures. For flooding, analysis of site-specific structures takes into account the depth of water in relation to the structure. Hazus-MH also takes into account the actual dollar exposure to the structure for the costs of building reconstruction, content, and inventory. However, damages are based upon the assumption that each structure will fall into a structural class, and structures in each class will respond in a similar fashion to a specific depth of flooding. Site-specific analysis is also based upon a point location rather than a polygon, therefore the model does not account for the percentage of a building that is inundated. These assumptions suggest that the loss estimates for site-specific structures as well as for aggregate structural losses need to be viewed as approximations of losses that are subject to considerable variability rather than as exact engineering estimates of losses to individual structures.

Future Development

Since Marshall County is vulnerable to a variety of natural hazards, the county government—in partnership with state government—must make a commitment to prepare for the management of these events. Marshall County is committed to ensuring that county elected and appointed officials become informed leaders regarding community hazards so that they are better prepared to set and direct policies for emergency management and county response.

The Marshall County Emergency Management Director will work to keep the jurisdictions covered by the Hazard Mitigation Plan engaged and informed during the plan's 5-year planning cycle. By keeping jurisdictional leaders actively involved in the monitoring, evaluation and update of the HMP, they will keep their local governments aware of the hazards that face their communities and how to mitigate those hazards through planning and project implementation. Each jurisdiction has identified mitigation strategies that they will seek to implement in their communities (see Appendix G: Mitigation Actions by Jurisdiction). Jurisdictions will include considerations for hazard mitigation in relation to future development when updating local comprehensive plans or other plans that may influence such development.

Hazard Profiles

4.1 Flash Flood and Riverine Flood

Hazard Description

Flooding is a significant natural hazard throughout the US. The type, magnitude, and severity of flooding are functions of the amount and distribution of precipitation over a given area, the rate at which precipitation infiltrates the ground, the geometry of the catchment, and flow dynamics and conditions in and along the river channel. Floods in Marshall County can be classified as one of two types: Flash floods or riverine floods. Both types of floods are common in Indiana.

Flash floods generally occur in the upper parts of drainage basins and are generally characterized by periods of intense rainfall over a short duration. These floods arise with very little warning and often result in locally intense damage, and sometimes loss of life, due to the high energy of the flowing water. Flood waters can snap trees, topple buildings, and easily move large boulders or other structures. Six inches of rushing water can upend a person; another 18 inches might carry off a car. Generally, flash floods cause damage over relatively localized areas, but they can be quite severe in the areas in which they occur. Urban flooding is a type of flash flood. Urban flooding involves the overflow of storm drain systems and can be the result of inadequate drainage combined with heavy rainfall or rapid snowmelt. Flash floods can occur at any time of the year in Indiana, but they are most common in the spring and summer months.

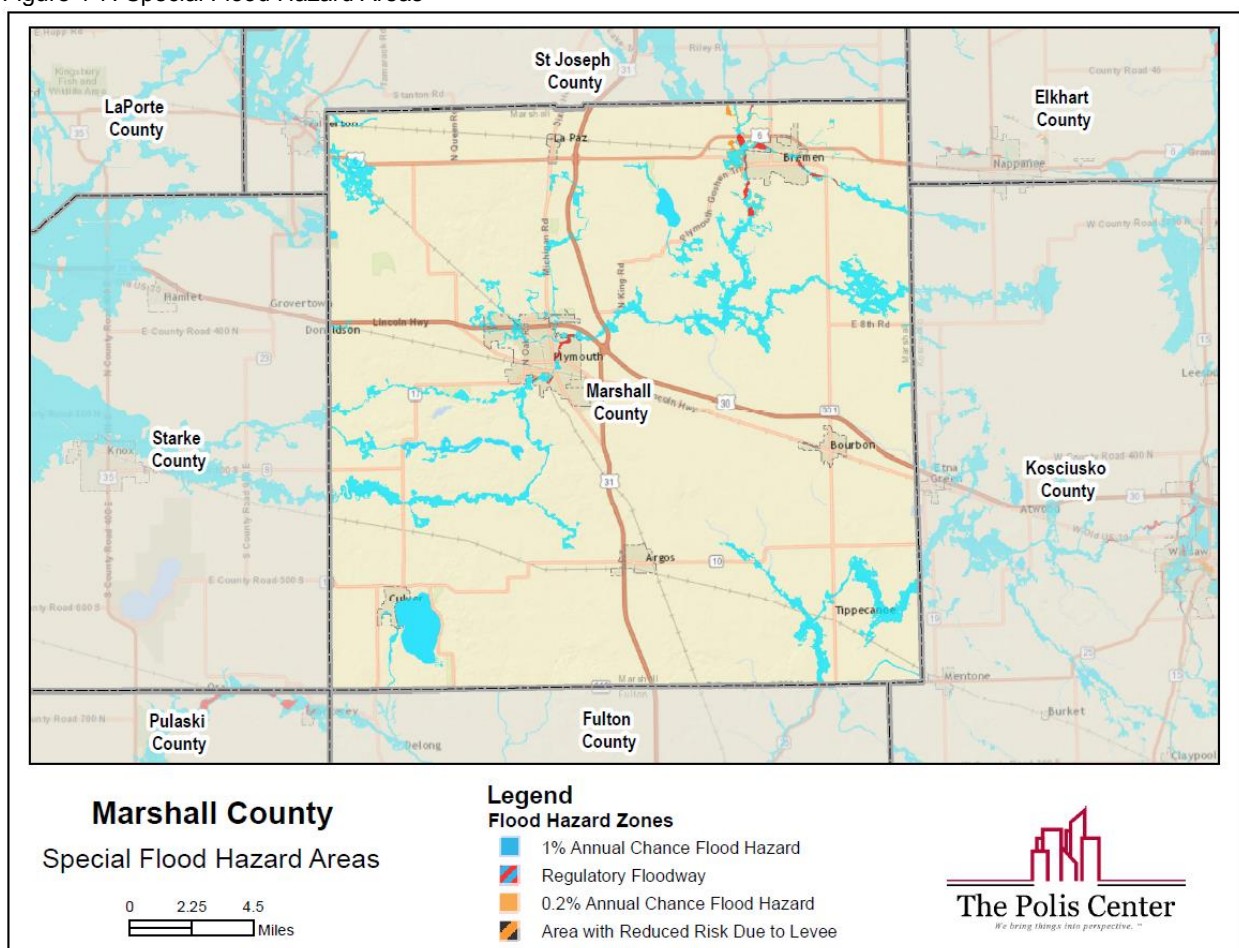
Riverine floods refer to floods on large rivers at locations with large upstream catchments. Riverine floods are typically associated with precipitation events that are of relatively long duration and occur over large areas. Flooding on small tributary streams may be limited, but the contribution of increased runoff may result in a large flood downstream. The lag time between precipitation and time of the flood peak is much longer for riverine floods than for flash floods, generally providing ample warning for people to move to safe locations and, to some extent, secure some property against damage. Riverine flooding on the large rivers of Indiana generally occurs during either the spring or summer.

The Special Flood Hazard Area (SFHA) are defined as the area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. The 1% annual chance flood is also referred to as the base flood or 100-year flood. The Federal Emergency Management Agency (FEMA) provided the Digital Flood Insurance Rate Map (DFIRM) that identifies the

SFHA. Flood hazard scenarios were modeled using GIS analysis and Hazus-MH. The existing DFIRM maps were used to identify the areas of study. Planning team input and a review of historical information provided additional information on specific flood events.

If a structure is located in a high-risk area, the owner is required to purchase flood insurance if they have a mortgage through a federally regulated or insured lender. Flood insurance is not federally required in moderate- to low-risk areas, but it's still a good idea. In fact, people in these areas file more than 20 percent of all National Flood Insurance Program (NFIP) flood insurance claims. Most homeowners in moderate- to low-risk areas can get coverage at a reduced rate. [Preferred Risk Policy](#) (PRP) premiums, the lowest premiums available through the NFIP, offer building and contents coverage for one low price. If person does not qualify for a PRP, a standard-rated policy is still available. The map displays the published FEMA FIRM, which is the reference for the NFIP.

Figure 4-7: Special Flood Hazard Areas



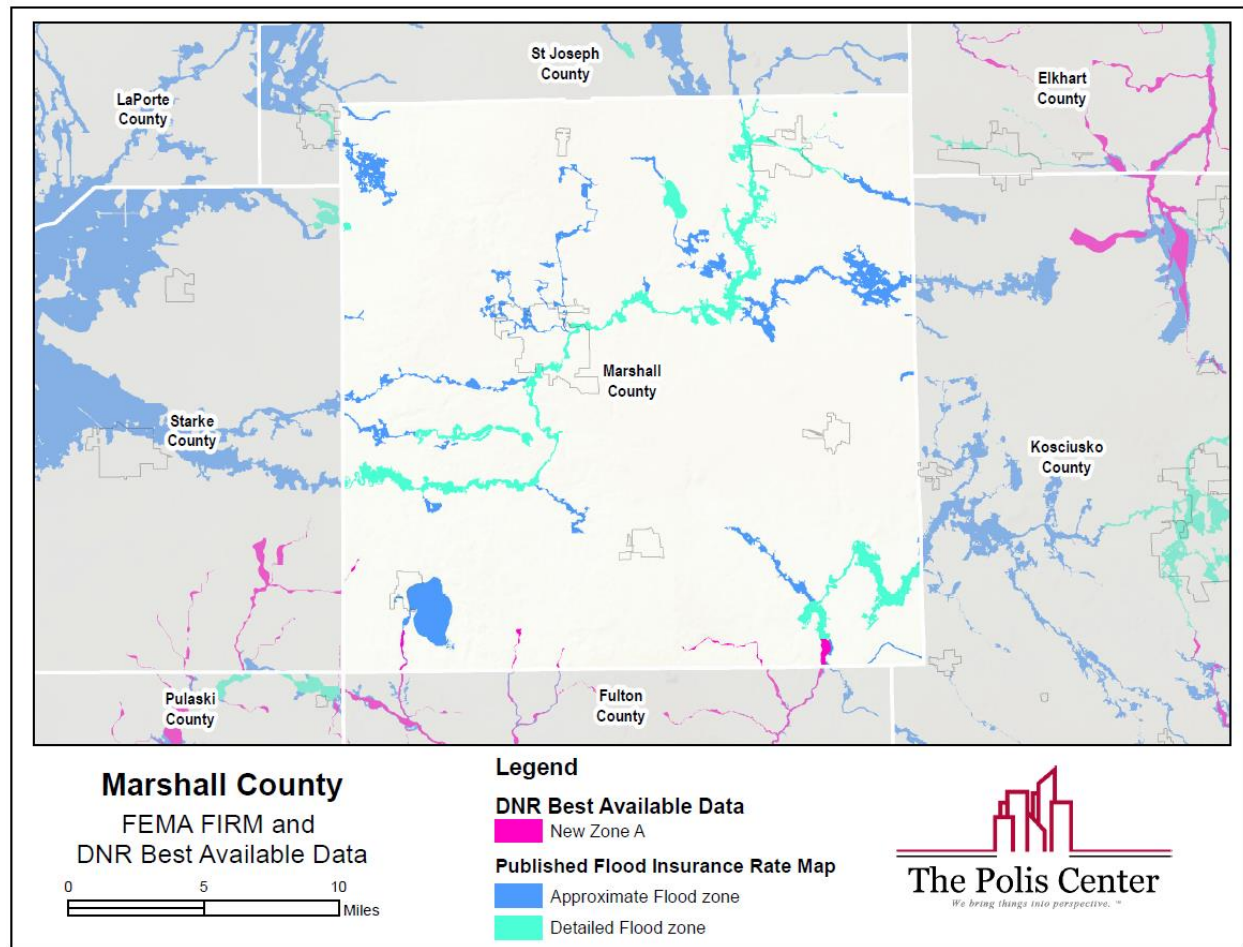
Best Available Data

The Indiana Floodplain Information Portal (INFIP) is a mapping application hosted by the IDNR. The website provides floodplain information to citizens and local officials, including floodplain data and flood elevation data for select streams. The portal displays the following floodplain layers: FEMA effective mapping (DFIRM), FEMA preliminary mapping and the IDNR Best Available Flood Hazards Areas.

The "Effective Special Flood Hazard Area" (Effective), is the National Flood Hazard Layer (NFHL) as published by FEMA. This map data is developed from Flood Insurance Rate Maps (FIRM) and Letters of Map Revisions (LOMR). The NFHL is the layer used in the Hazus-MH analysis. The preliminary mapping layer includes proposed NFHL data by FEMA.

The "Best Available Flood Hazard Area" (Best Available) includes the Effective mapping, as well as additional studies that have been approved by the IDNR. While this data has not yet been submitted to FEMA for inclusion in the NFHL, this data can be used for general planning, construction, and development purposes. These maps however, are not to be used for NFIP purposes. Figure 4-8 identifies the stream reaches that have Best Available SFHA data on the INFIP.

Figure 4-8: Marshall County Best Available Special Flood Hazard Areas



Flood History in Marshall County

According to the Marshall County Flood Insurance Study, the major flood problems in Marshall County are the overflow of the Yellow and Tippecanoe Rivers. The three largest recorded floods for the Yellow River occurred in October 1955, March 1982, and February 1985, with recurrence intervals greater than 1% annual chance for the floods of 1955 and 1982 and less than 1% annual chance for the flood of 1985. The three largest recorded floods for the Tippecanoe River occurred in April 1950, June 1981, and March 1982, with recurrence intervals of 4% annual chance for the flood of 1950 and less than 100 years for the floods of 1981 and 1982.

The City of Plymouth, Tippecanoe and German Township are prone to flooding. There have been 4 flood and 4 flash flood hazard events recorded in the hazard recorded data provided by the NWS and NOAA, from 1965-2016. A list of the hazard event dates, deaths, injuries, property damage are listed in Appendix C.

Plymouth has faced two record flash flood events, both on July 18, 2007. The 2007 event recorded \$15,000 in damaged, which resulted in several roads were closed in the southern part of the county by flowing water around 1 foot deep. The 2015 event recorded 2.47 inches of rain in 1.5 hours and resulted in extensive road flooding in Plymouth.

The January 2008 was a result of an unseasonable moist atmosphere and slow moving cold front. The existing dense snowpack rapidly melted because of the warm temperatures and rainfall, resulting in several county and some city roads experienced high water on them for a few days which resulted in \$150,000 in reported damage. Low areas, ditches and creeks exceeded capacity from one to three inches of rain. Residences in and around Plymouth as a result of flood waters.

The March 2009 event resulted in \$300,000 in damage, as a result of averaged between two and four inches in many locations. The Yellow River came out of its banks, cresting around 14.2 feet, which resulted in streets and some properties in the flood plains of the river to become inundated with water. Some evacuations were necessary as water levels rose quickly.

The June 2015 rainfall brought flooding to many counties during a couple day period where on average, three to five inches of rain fell, often in a few hours. This rainfall occurred over already saturated ground from recent rains over the past couple of weeks. Numerous reports of high water and general flooding throughout Plymouth, with several inches of standing water. Other reports of high water were reported throughout the county, especially in the Tippecanoe area.

Figure 4-9: Historic Rainfall Figure from Tribune on August 15-16, 2016

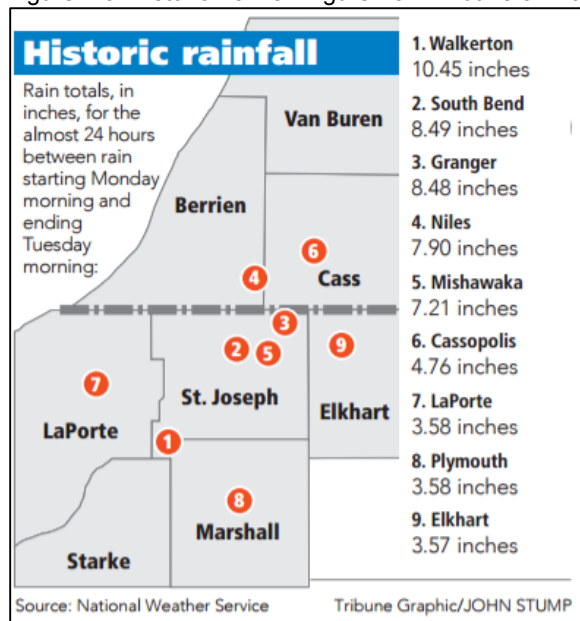


Figure 4-10: Plymouth Residential Flooding, August 15-16, 2016



Figure 4-11: Flooding Plymouth, June 2015



Stream gages

The USGS in cooperation with many state agencies and local utility and surveyor offices help maintain stream gages, which provide the capability to obtain estimates of the amount of water flowing in streams and rivers. Most USGS stream gages operate by measuring the elevation of the water in the river or stream and then converting the water elevation (called 'stage') to a streamflow ('discharge') by using a curve that relates the elevation to a set of actual discharge measurements. For many of the public freshwater lakes in northern Indiana, local and state partners utilize staff gages, which dictate the location of the last visit.

The DNR and IDEM utilize the stream gage data for water quantity and quality measurements. Local public safety officials utilize the data at these sites, along with the resources from the NWS, to determine emergency management needs during periods of heavy rainfall. There are two gages in the county, including the Yellow River at Plymouth and a recently removed gage near Bremen.

The figure below shows the locations of these gages and the available NCDC Weather Stations. The tables then display the top 10 gage events.

Figure 4-12: USGS Stream Gages and NCDC Weather Stations

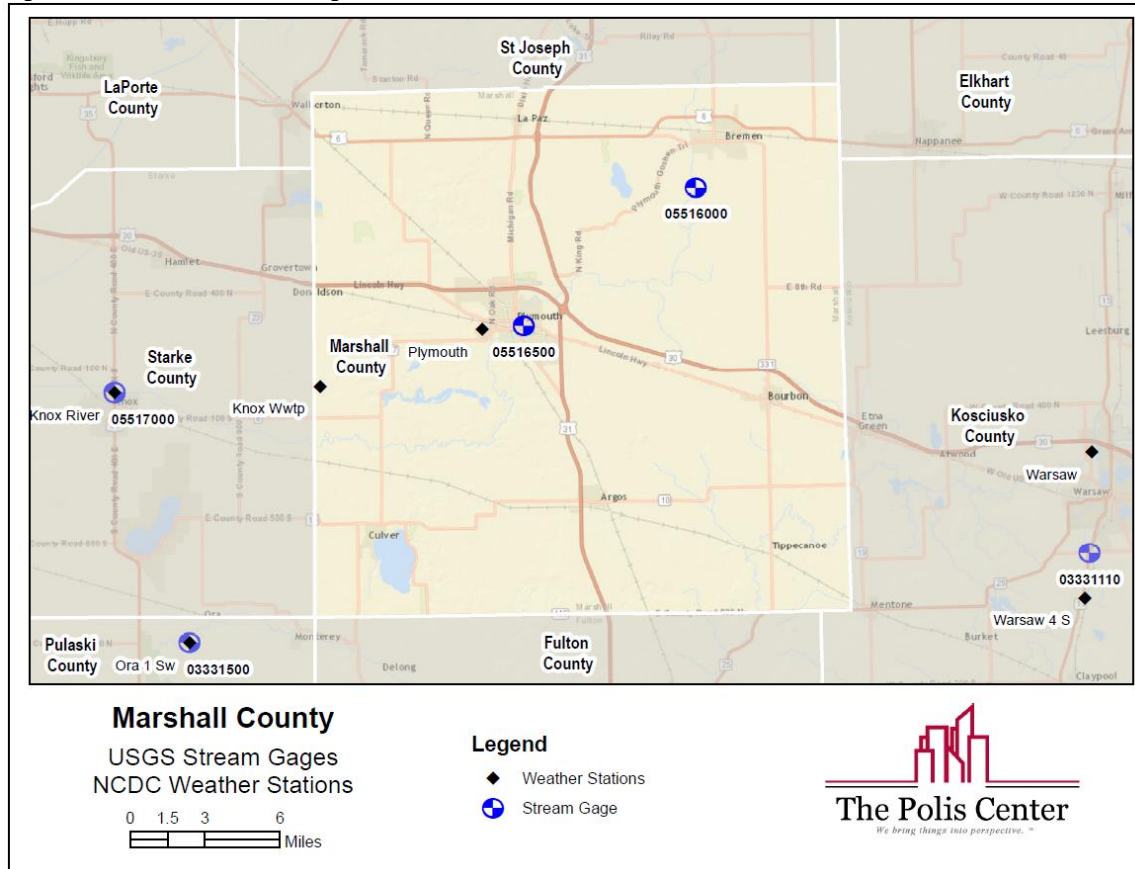


Table 4-12: Peak Streamflow at 05516500 Yellow River at Plymouth, IN

Date	Gage Height	Stream flow
Oct. 12, 1955	17.13	5,390
Mar. 16, 1982	16.37	4,730
Feb. 26, 1985	15.68	3,920
Jan. 01, 1991	15.3	3,930
Jan. 10, 2008	15.13	4,010
Mar. 24, 1978	15.01	3,380
Mar. 12, 2009	14.68	3,420
Jan. 15, 2005	14.57	3,350
Feb. 12, 2001	14.28	3,170
Jan. 06, 1993	14.25	3,200

Utilizing the data provided by the stream gage, the City of Plymouth also has a Flood Inundation Map developed for the Yellow River. This 4.9 mile stretch of the Yellow River can be accessed

through the USGS Flood Inundation Mapping Science Web site at http://water.usgs.gov/osw/flood_inundation/, depict estimates of the areal extent and depth of flooding corresponding to selected water levels (stages) at the USGS stream gage 05516500, Yellow River at Plymouth, Ind. This initiative was in cooperation with the Indiana Office of Community and Rural Affairs.

Vulnerability and Future Development

There has been some channel cleaning in the past. Within the study, areas of the county there are no flood control reservoirs, dams, or flood control projects planned to provide protection from the effects of a 1 % chance flood. There are, however, numerous structures in the areas studied which could have significant effects on the floods of lower magnitudes.

Flash flooding may affect nearly every location within the county; therefore, all buildings and infrastructure are vulnerable to flash flooding. Currently, the Marshall County planning commission reviews new development for compliance with the local zoning ordinance.

Areas with recent development within the county may be more vulnerable to drainage issues. Storm drains and sewer systems are usually most susceptible. Damage to these can cause the back up of water, sewage, and debris into homes and basements, causing structural and mechanical damage as well as creating public health hazards and unsanitary conditions.

Controlling floodplain development is the key to reducing flood-related damages. Marshall County also seeks to protect numerous areas of environmental sensitivity—for example, riparian areas, wetland areas, and woodlands. These areas serve as wildlife habitats, provide natural filtration of water, and recharge underground aquifers; examples include the Yellow River, Lake of the Woods, and the Menominee Wetlands. The county plans to develop and implement zoning ordinances to prohibit future development in conservation and floodplain areas.

Residents that have suffered damage to their home or business from recent flooding should contact the Building Department or 311 to schedule a storm damage assessment visit.

In addition, depending on a property's location, a permit may be required from the Indiana Department of Natural Resources prior to the start of any reconstruction activity. Failure to obtain the necessary permits could result in fines. For more information on the local permitting requirements, please contact:

Marshall County Building Department
112 W. Jefferson Street Room 302
Plymouth, Indiana 46563
(574) 935-8531

The Marshall County Drainage Ordinance was adopted on April 4, 2011 and provides the county with guidance for the development and management of sewers and streams. Recognizing that smaller streams and drainage channels serving Marshall County may not have sufficient capacity to receive and convey water runoff, it is the policy of the Marshall County Commissioners that the storage and controlled release of storm water runoff shall be required of all new development, any redevelopment and other new construction in Marshall County. The release rate of storm water from developed, lands shall not exceed the release rate from the land area in its present land use. Furthermore, the Storm Water Drainage Ordinance Marshall County, Indiana states, "Because topography and the availability and adequacy of outlets for storm runoff vary with almost every site, the requirements for storm drainage tend to be an individual matter for any project. It is recommended that each proposed project be discussed with the Marshall County Surveyor and Plan Director at the earliest practical time in the planning stage."

In Plymouth, Philip Gaul, City of Plymouth Director of Public Works and City Engineer, oversees the city's public works and storm water management services and initiatives and reviews streets for problem areas.

For all new development, Marshall County's Zoning Ordinance requires that all land owners be responsible for adequate surface water drainage on any parcel used for any purpose other than agricultural cultivation. For retention, detention, and pond edges, the ordinance requires a buffer within twenty feet of the point of peak elevation. The development standards laid out in the zoning ordinance include the following measures for addressing surface water concerns.

Risk Analysis

User Input

Since accurate, published floodplain mapping can be difficult to manage on top of development the FIRM analysis may not always be suffice in understanding the flood exposure. In addition, the FIRM analysis, the Best Available Data can produce an improved assessment of more streams.

The original Marshall County plan identified two areas of vulnerability, which were located outside of the mapped Special Flood Hazard Area. Since these areas were in distinct locations, they have been mapped separately in Figures 4-13 and 4-14 and show are shown in relation to incorporated communities. Beginning with figure 4-15, locations of existing flooded areas, roads, and intersections have been compiled by EMA directors and provided to IDHS.

Figure 4-13: Unmapped Flooding Between Argos and Bourbon



Figure 4-14: Unmapped Flooding West of Bremen

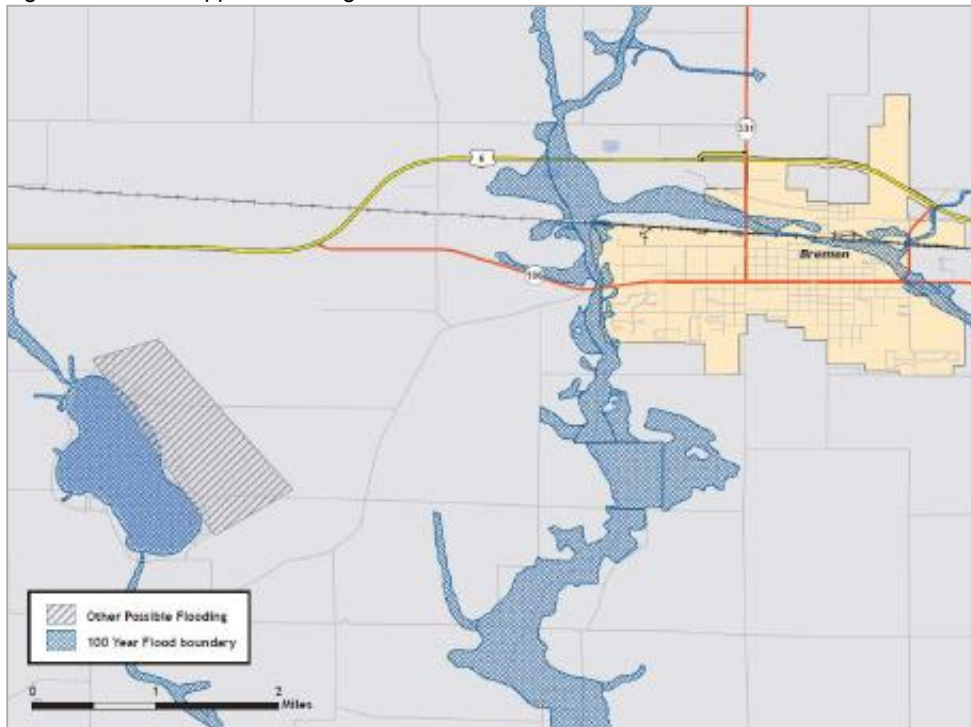


Figure 4-15: Flooded Intersections and Road Areas

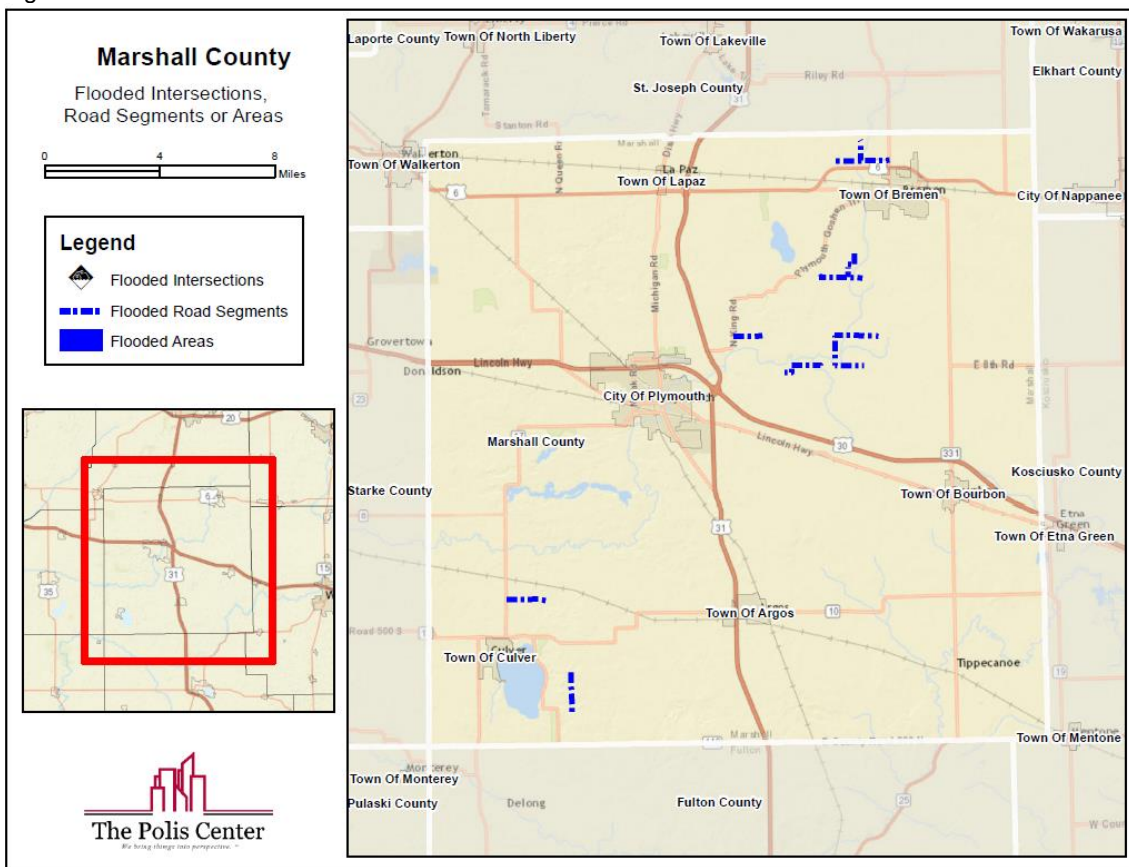


Figure 4-16: Local input Flooded Roads East of Culver

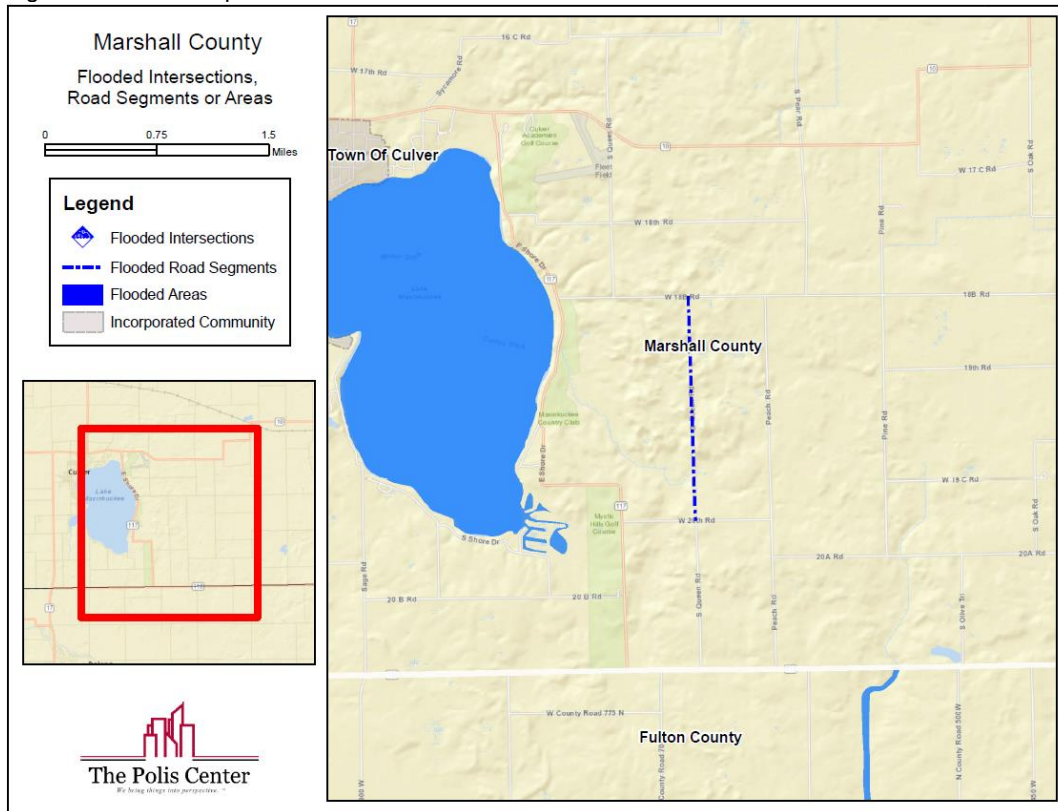


Figure 4-17: Local input Flooded Roads North of Culver

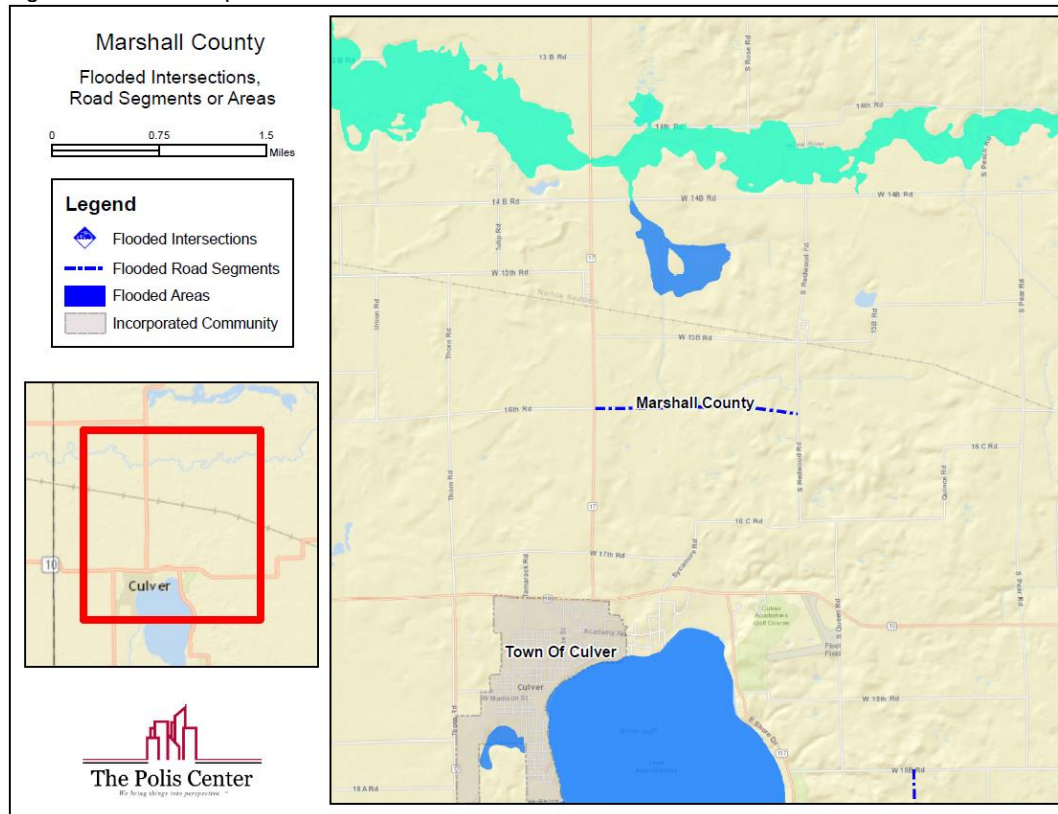


Figure 4-18: Local input Flooded Roads East of Plymouth

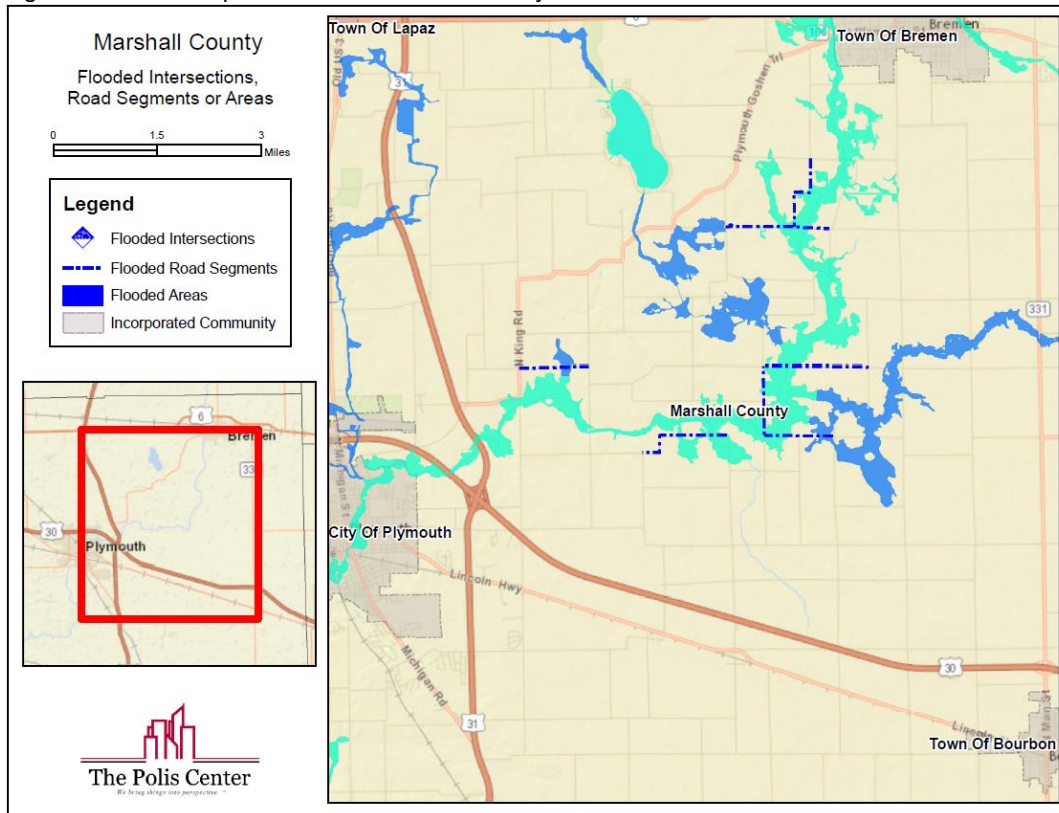


Figure 4-19: Local input Flooded Roads South of Bremen

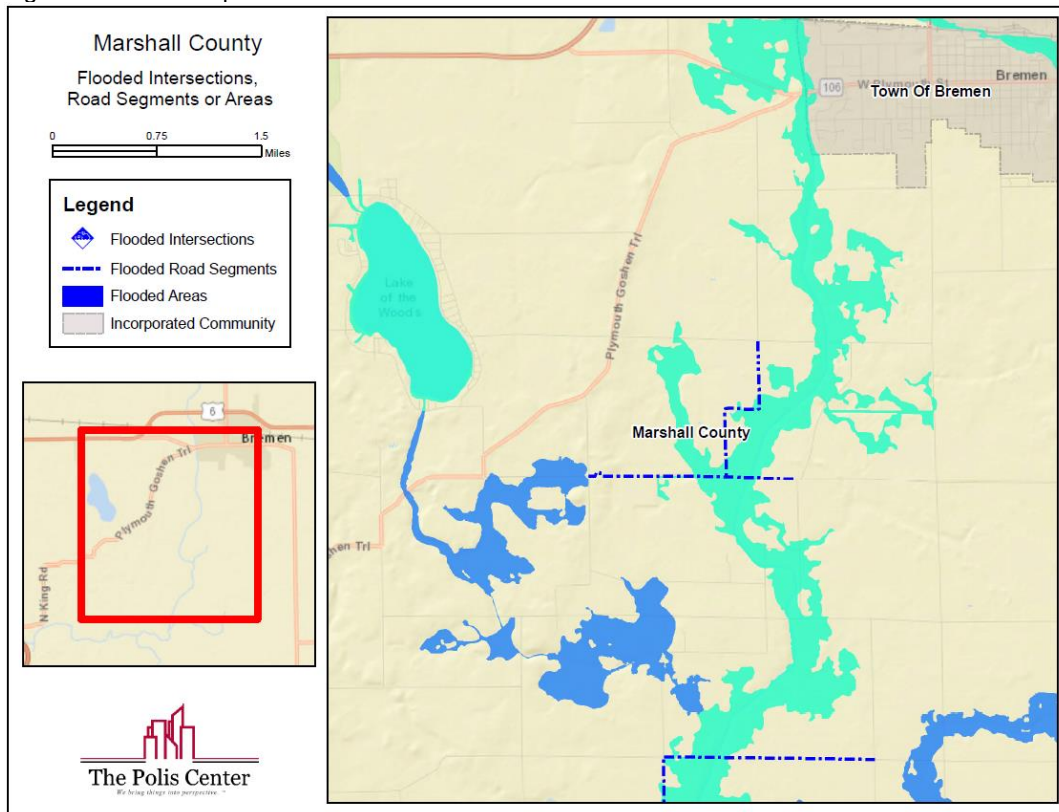
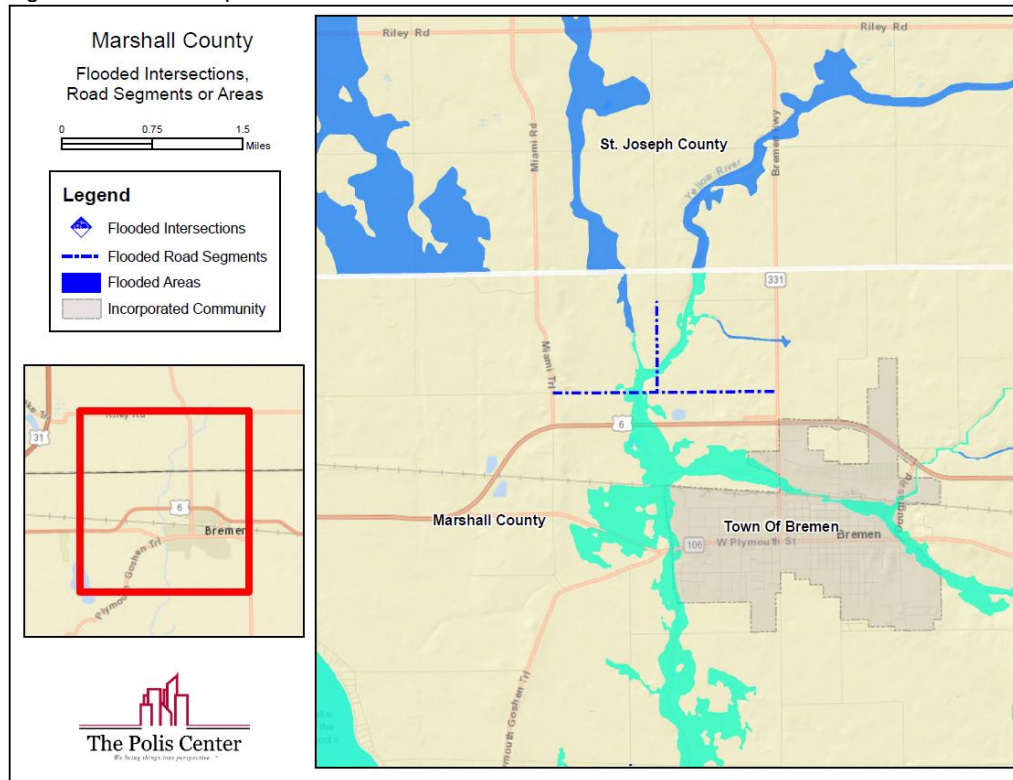


Figure 4-20: Local input Flooded Roads North of Bremen



Along with existing locations of flooding problems, the DNR tracks permit and floodplain requests. This can be an indication of locations of development or potential mapping problems. The following maps display the requests handled by the DNR from 2006 to 2016.

Figure 4-21: DNR Construction Requests

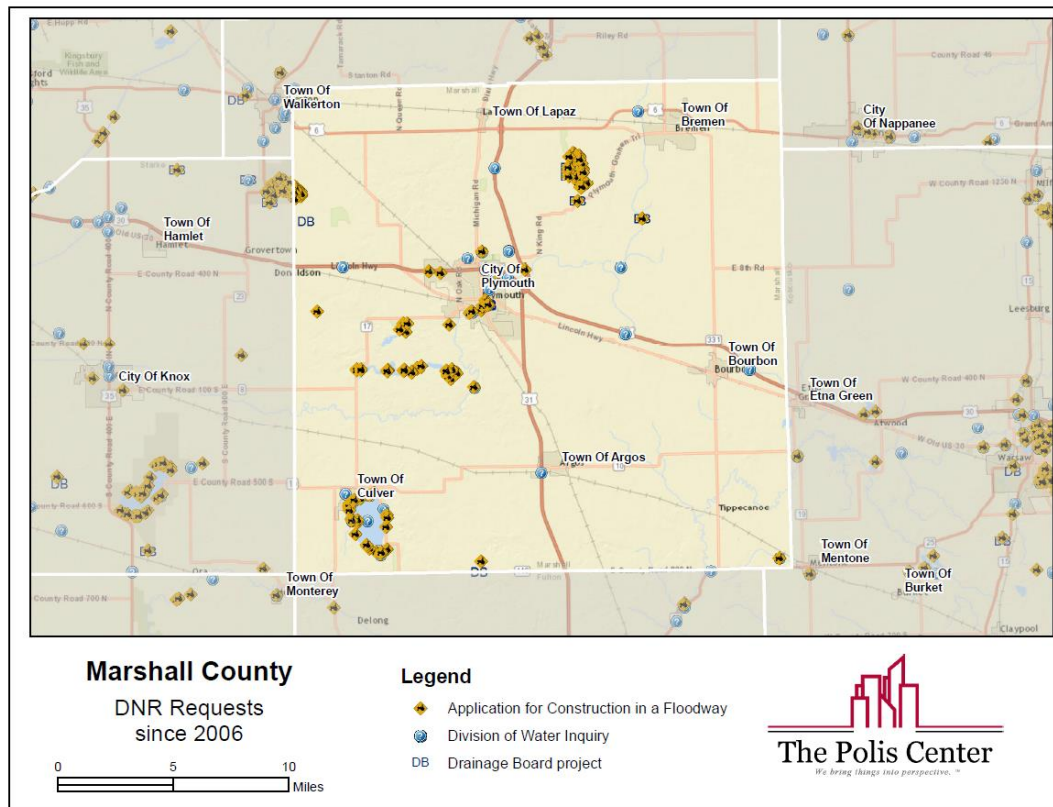
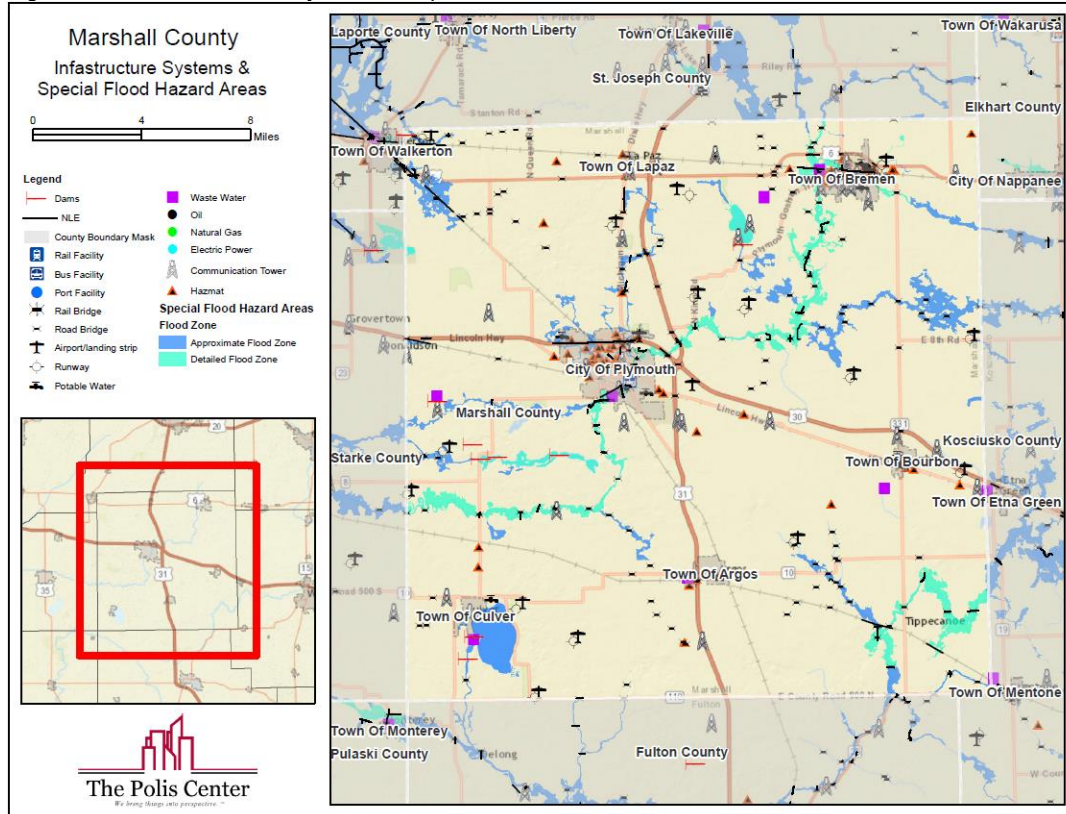


Figure 4-22: Infrastructure Systems in Special Flood Hazard Areas

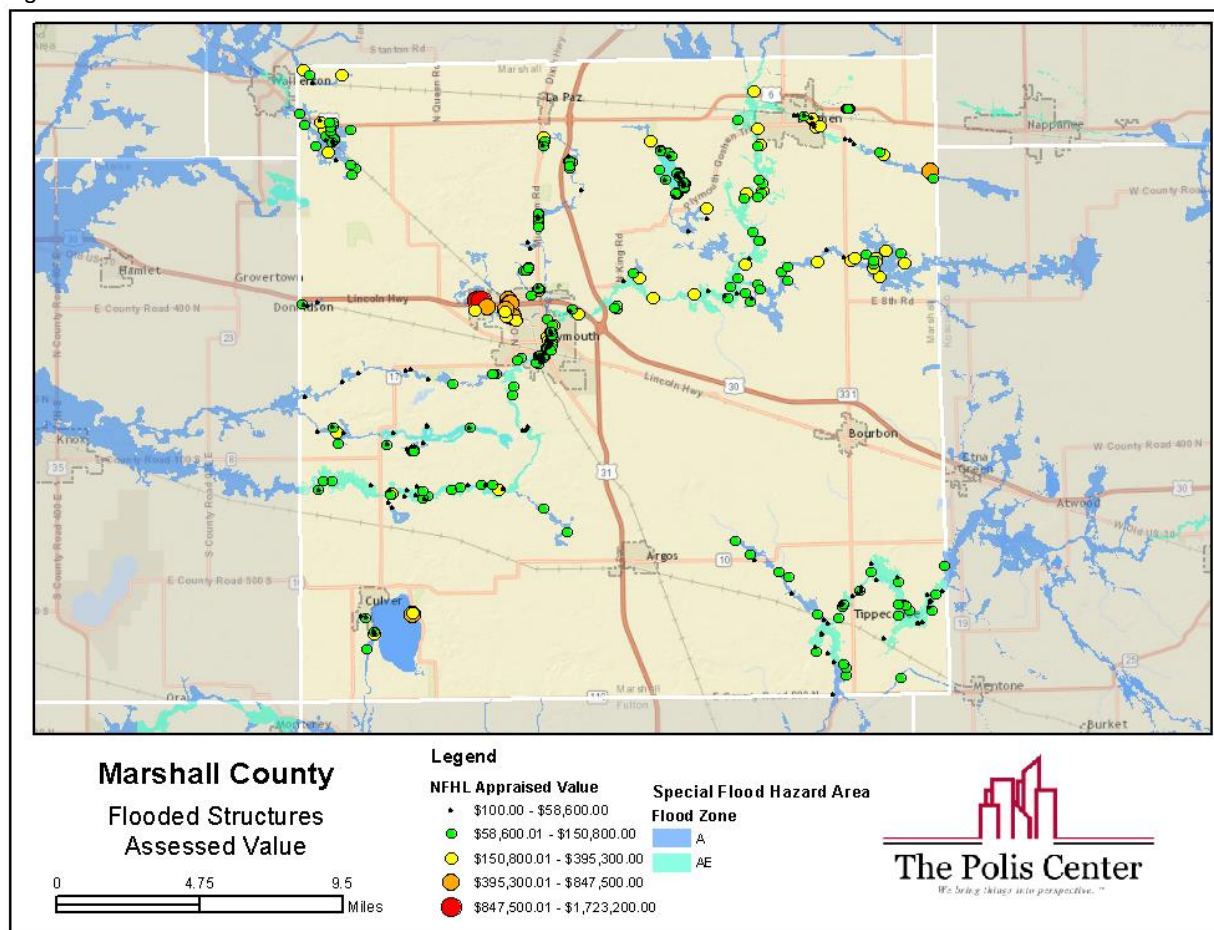


Exposure Analysis

An exposure analysis identifies the existing and future assets located in identified hazard areas, often by using GIS for analysis and maps for visualization. Exposure analysis can quantify the number, type, and value of structures, critical facilities, and infrastructure located in identified hazard areas, as well as assets exposed to multiple hazards. The analysis also can take into account the magnitude of the flood frequency area (1% annual flood, AE/Floodway and 0.2% annual flood risk).

Below the team has analyzed the structures within each community in the number 1% annual chance flood is considered a high-risk area as well as presented the appraised values for these structures.

Figure 4-23: Flooded Structures Assessed Value



Further analysis is provided on the Best Available mapping layers, which are provided by DNR for floodway references but are not to be used for flood insurance determinations. A list of all

infrastructure systems and the floodplains are located in the appendix. The following tables present the total identified structures within the type of published special flood hazard area. The first table compares the totals of Zone A and Zone AE number of structure and the total appraised value. Zone A areas, are in locations where published elevation have not been established by FEMA. Zone AE areas have a floodway identified on the FIRM map along with an associated Floodway Data table and flood profile for Base Flood Elevation (BFE) reference for local floodplain permitting. The second table then combines the total structures and appraised value and further identifies the structures located within the Zone AE/Floodway. These structures are located in areas where fast moving floodwaters as opposed to pooling.

Table 4-13: Structures in Zone A or AE Appraised Value

	Zone A		Zone AE	
	Total Structures	Appraised Value	Total Structures	Appraised Value
Marshall County	152	\$27,022,540	163	\$11,721,500
Town of Bremen	-	-	4	\$603,130
Town of Culver	8	\$443,660	-	-
City of Plymouth	15	\$9,589,290	29	\$1,711,530

Source: Marshall County 2016 secured roll assessor and parcel date; Marshall County DFIRM, January 2011.

Table 4-14: Structures in Floodway and Zone A/AE Appraised Value

	Zone AE/Floodway		Zone AE + Zone A = Total	
	Total Structures	Appraised Value	Total Structures	Appraised Value
Marshall County	8	\$594,100	315	\$11,721,500
Town of Bremen	8	\$749,490	4	\$603,130
Town of Culver	-	-	8	\$38,744,040
City of Plymouth	40	\$2,506,820	44	\$11,300,820
Total	56	\$3,850,410	367	\$62,369,490

Source: Marshall County 2016 secured roll assessor and parcel date; Marshall County DFIRM, June 2017.

The following table presents the total number of parcels located within the Best Available and Published FIRM mapping zones.

Table 4-15: Parcel Total Counts in FIRM and BAD

	Total Parcels			
	Published FIRM		Best Available Data	
	Zone A/AE	Zone X	Zone A/AE	Zone X
Marshall County	3,169	22,682	3,477	22,679
Town of Bremen	115	2,583	115	2,583
Town of Culver	54	1,277	86	1,280
City of Plymouth	708	5,524	708	5,254
Town of Argos	-	1,132	-	1,132
Town of Bourbon	-	1,021	-	1,021
Town of La Paz	-	474	-	474
Total	4,061	34,568	4,409	34,567

Source: Marshall County 2016 secured roll assessor and parcel date; DFIRM- 2011, BAD- June 2017.

The total structures in the Special Flood Hazard Area are based on approximate building locations; therefore, it should not be used as an absolute comparison although this information may still be used to further mitigation through encouraging engagement with the NFIP. Additionally, this may serve as a tool to help determine if there would be an interest in becoming involved in a discount program with the Community Rating System (CRS).

Table 4-16: Community Structure Count and Number of Policies

	Structures in Zone A/AE	Number of Policies
Marshall County	315	50
Town of Bremen	4	5
Town of Culver	8	1
City of Plymouth	44	30
Total	367	86

Source: Marshall County 2011 FIRM; FEMA Indiana NFIP report, June 2017.

Historical Analysis

A historical analysis can be helpful to understand the impacts and losses from previous hazard events to protect from similar future events. A repetitive loss property: an NFIP insured structure that has had at least two paid flood losses of more than \$1,000 each in any 10-year period since 1978.

FEMA Region V was contacted to determine the type of repetitive loss structures and their location. Severe repetitive loss properties single or multifamily residential properties that are covered under an NFIP flood insurance policy and:

1. That have incurred flood-related damage for which 4 or more separate claims payments have been made, with the amount of each claim (including building and contents payments) exceeding \$5,000, and with the cumulative amount of such claims payments exceeding \$20,000; or
2. For which at least 2 separate claims payments (building payments only) have been made under such coverage, with cumulative amount of such claims exceeding the market value of the building.
3. In both instances, at least 2 of the claims must be within 10 years of each other, and claims made within 10 days of each other will be counted as 1 claim.

The City of Plymouth has 18 residential repetitive loss properties, including; 12 single family homes and 3 non-residential properties. These non-mitigated loss properties have amounted in building payments of \$422,762 totaling 60 losses. There have been 4 mitigated single family homes in Plymouth. There were no other repetitive loss properties in the county.

Continued NFIP compliance is an important cornerstone of mitigation. The NFIP program and flood insurance policies provide tools for communities to mitigate their own flood risks. The mitigation staff is committed to promoting NFIP compliance and preventing structure's from being built in harm's way. Total community losses and payments are identified in Table 4-19.

Table 4-17: Community Loss and Payments Totals

NFIP Community	Total Losses	Closed without Payment	Total Payments
Marshall County	7	2	\$7,628
Town of Bremen	1	1	\$0
Town of Culver	1	0	\$26,200
City of Plymouth	158	20	\$778,610
Total	167	23	\$812,438

A FEMA-approved MHMP is required in order to apply for and/or receive project grants under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and Severe Repetitive Loss (SRL). FEMA may require a MHMP under the Repetitive Flood Claims (RFC) program. Although the Marshall County MHMP meets the requirements of DMA 2000 and eligibility requirements of these grant programs, additional detailed studies may need to be completed prior to applying for these grants.

FEMA provides annual funding through the National Flood Insurance Fund (NFIF) to reduce the risk of flood damage to existing buildings and infrastructure. These grants include Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and the Severe Repetitive Loss (SRL)

program. The long-term goal is to significantly reduce or eliminate claims under the NFIP through mitigation activities.

FEMA defines a repetitive loss structure as a structure covered by a contract of flood insurance issued under the National Flood Insurance Program (NFIP), which has suffered flood loss damage on two occasions during a 10-year period that ends on the date of the second loss, in which the cost to repair the flood damage is 25% of the market value of the structure at the time of each flood loss.

Combining Available Data and Methods

Hazus-MH was used to estimate the damages incurred for a 1% annual chance flood event in Marshall County using a Q3 and a 10-meter DEM (digital elevation model) to create a flood depth grid. Hazus-MH was used to generate a flood depth grid for a 1% annual chance food return period based upon the DFIRM boundary and a 1/3 ArcSecond DEM provided by the Indiana Geological Survey. Hazus-MH was then used to perform a user-defined facility analysis of Marshall County. This was accomplished by creating points representing building locations that were generated from IDLGF-provided assessor data linked to parcel data provided by the county (through IDHS and IndianaMap). These data were then analyzed to determine the depth of water at the location of each building point and then related to depth damage curves to determine the building losses for each structure.

Marshall County specific building data was sourced from the parcel tax databases and building location point databases included building valuations and occupancy class. Building counts were aggregated from the individual parcel records to the relevant census administrative boundaries.

Hazus-MH estimates the Special Flood Hazard Areas would damage 458 buildings county-wide at a cost of \$27.9 million. In the modeled scenario Plymouth sustained the most damage with 106 buildings damaged at a cost of \$14.1 million. The total estimated numbers and cost of damaged buildings by community are given in Tables 4-18 and 4-19. Figure 4-24 depicts the Marshall County buildings that fall within the SFHA. Figures 4-24 through 4-27 highlight damaged buildings within the floodplain areas in each flood prone community.

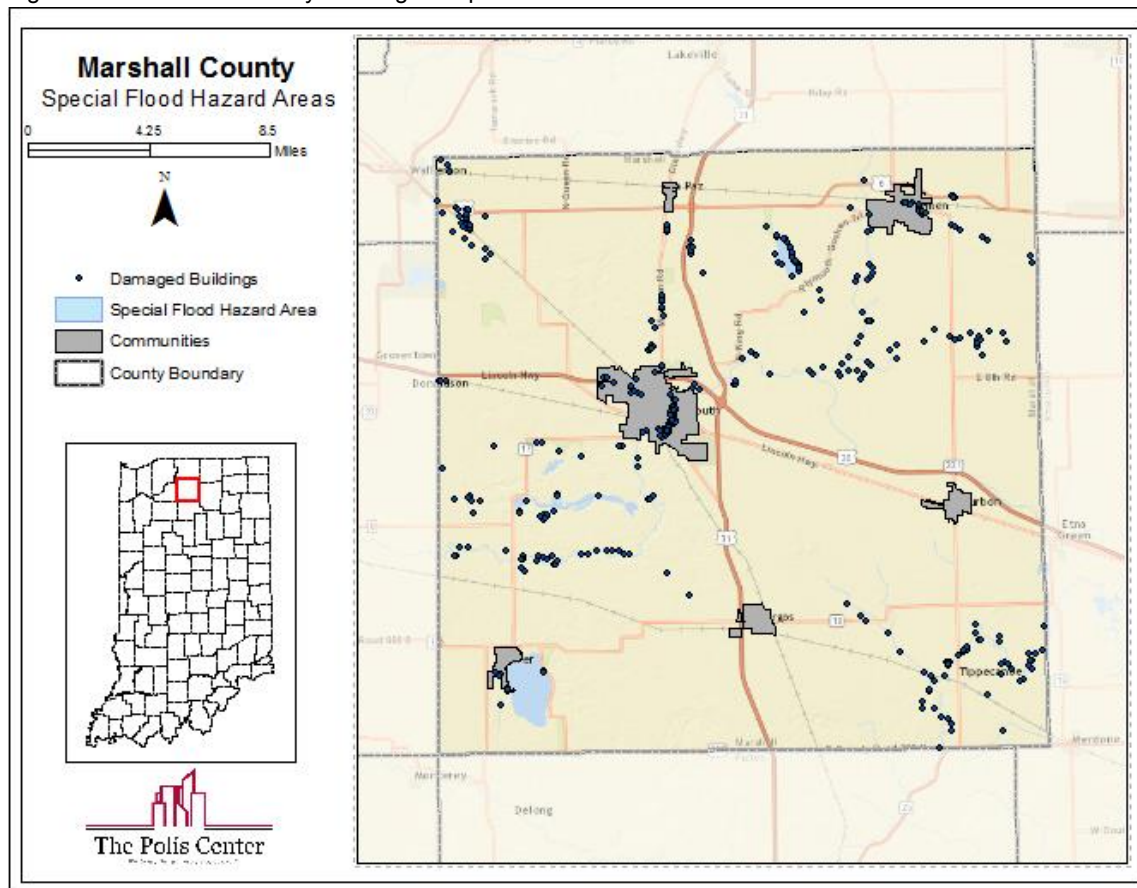
Table 4-18: Number of Buildings Damaged by Community and Occupancy Class

Community	Total Buildings Damaged	Building Occupancy Class						
		Agriculture	Commercial	Educ.	Govt.	Industrial	Religious	Residential
Marshall Co. (unincorporated)	327	92	5	0	1	2	2	225
Bremen	17	0	5	0	2	3	0	7
Culver	8	0	0	0	1	0	0	7
Plymouth	106	0	24	0	21	7	6	48
Total	458	92	34	0	25	12	8	287

Table 4-19: Cost of Buildings Damaged by Community and Occupancy Class

Community	Cost Buildings Damaged	Building Occupancy Class						
		Agriculture	Commercial	Educ.	Govt.	Industrial	Religious	Residential
Marshall Co. (unincorporated)	\$11,879,966	\$1,932,513	\$693,029	\$0	\$693,029	\$3,602	\$10,807	\$8,776,849
Bremen	\$1,672,750	\$0	\$564,355	\$0	\$280,755	\$583,989	\$0	\$243,650
Culver	\$334,631	\$0	\$0	\$0	\$17,542	\$0	\$0	\$317,089
Plymouth	\$14,106,240	\$0	\$3,473,457	\$0	\$2,213,825	\$5,381,958	\$1,481,898	\$1,555,100
Total	\$27,993,589	\$1,932,513	\$4,730,842	\$0	\$2,975,287	\$5,969,550	\$1,492,705	\$10,892,689

Figure 4-24: Marshall County Buildings in Special Flood Hazard Areas



Overlay Analysis of Essential Facilities

An essential facility will encounter many of the same impacts as other buildings within the flood boundary. These impacts can include structural failure, extensive water damage to the facility and loss of facility functionality (e.g. a damaged police station will no longer be able to serve the community). The overlay analysis estimates that only one essential facility stands to be damaged in the event of a flood. Grace Baptist Christian School is located within the special flood hazard area in the town of Plymouth. Figure 4-27 depicts this facility along with other essential facilities in the town of Plymouth that are in close proximity to the special flood hazard area.

Overlay Analysis of Critical Facilities

A critical facility will encounter many of the same impacts as other buildings within the flood boundary. These impacts can include structural failure, extensive water damage to the facility and loss of facility functionality. As an example, a damaged waste water facility would no longer be able to serve the community.

The Critical Facilities in Special Flood Hazard Areas figures show the results of the overlay analysis and indicate the Critical Facilities that are at risk of flood damage in Marshall County including one cell tower, one waste water treatment plant, and two Hazmat facilities.

Table 4-20: Impacted Critical Facilities

Facility Type	Facility Name
Communication	501 W. Lake Ave. Cell Tower
Waste Water Treatment	Culver Municipal
HAZMAT	Bpc Manufacturing
HAZMAT	Graphix Unlimited

Figure 4-25: Bremen Critical Facilities in Special Flood Hazard Areas

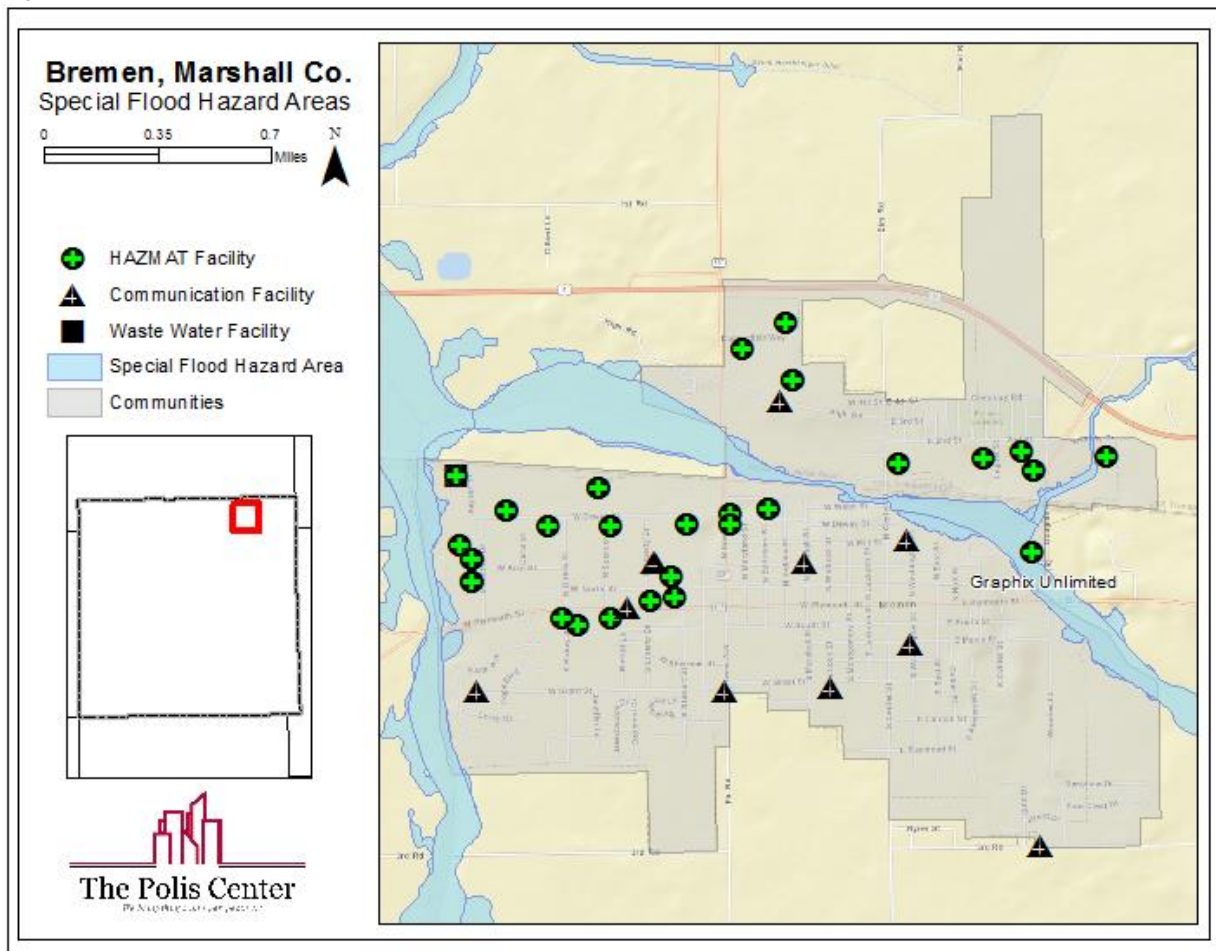


Figure 4-26: Culver Critical Facilities in Special Flood Hazard Areas

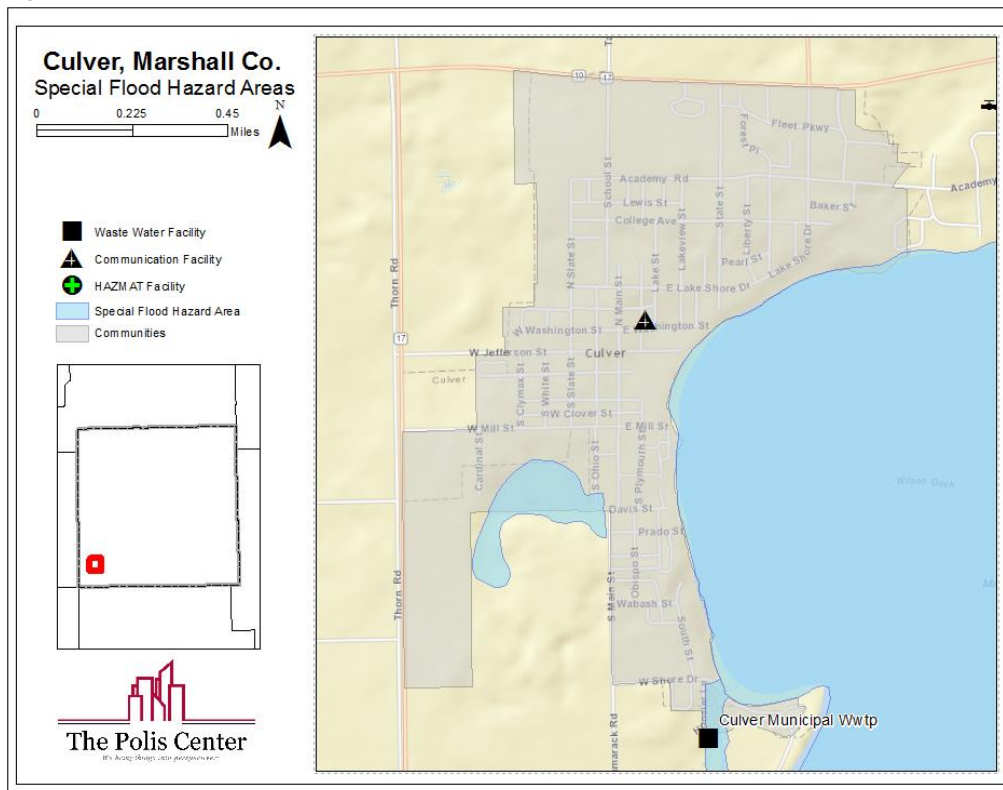
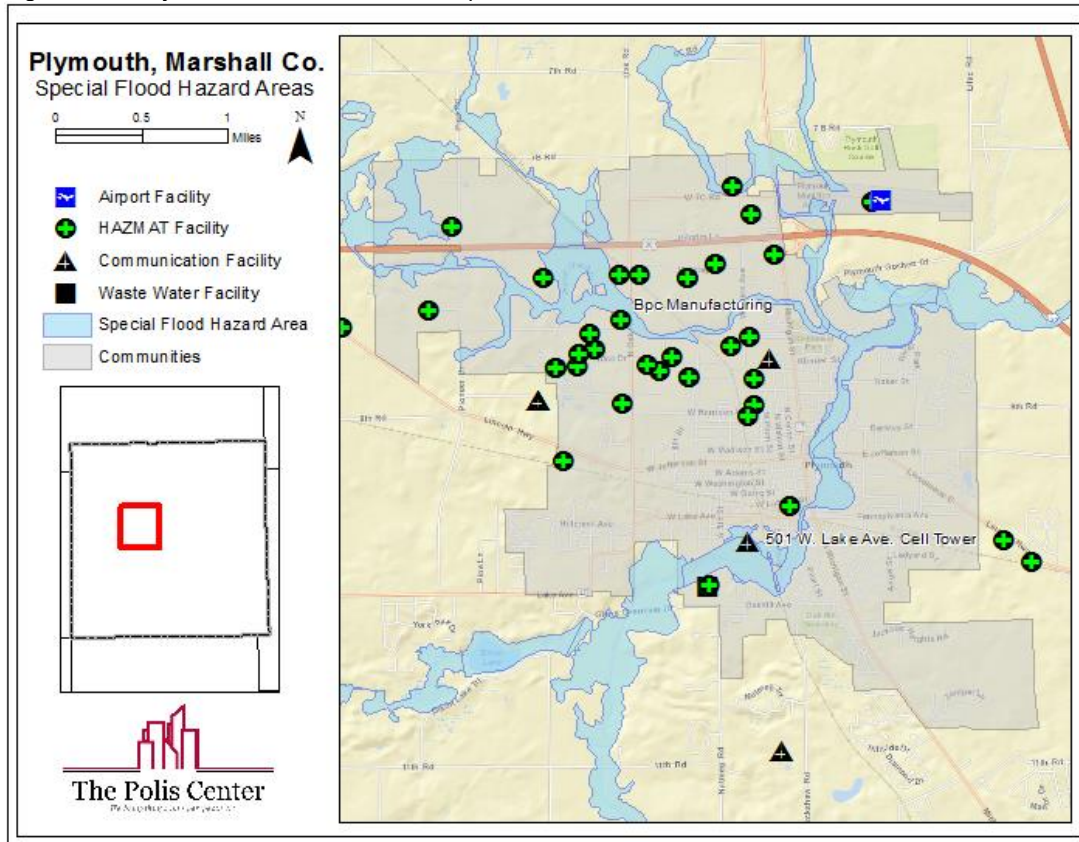


Figure 4-27: Plymouth Critical Facilities in Special Flood Hazard Areas



Short Term Shelter and Debris

Figure 4-28: Short Term Shelter Needs

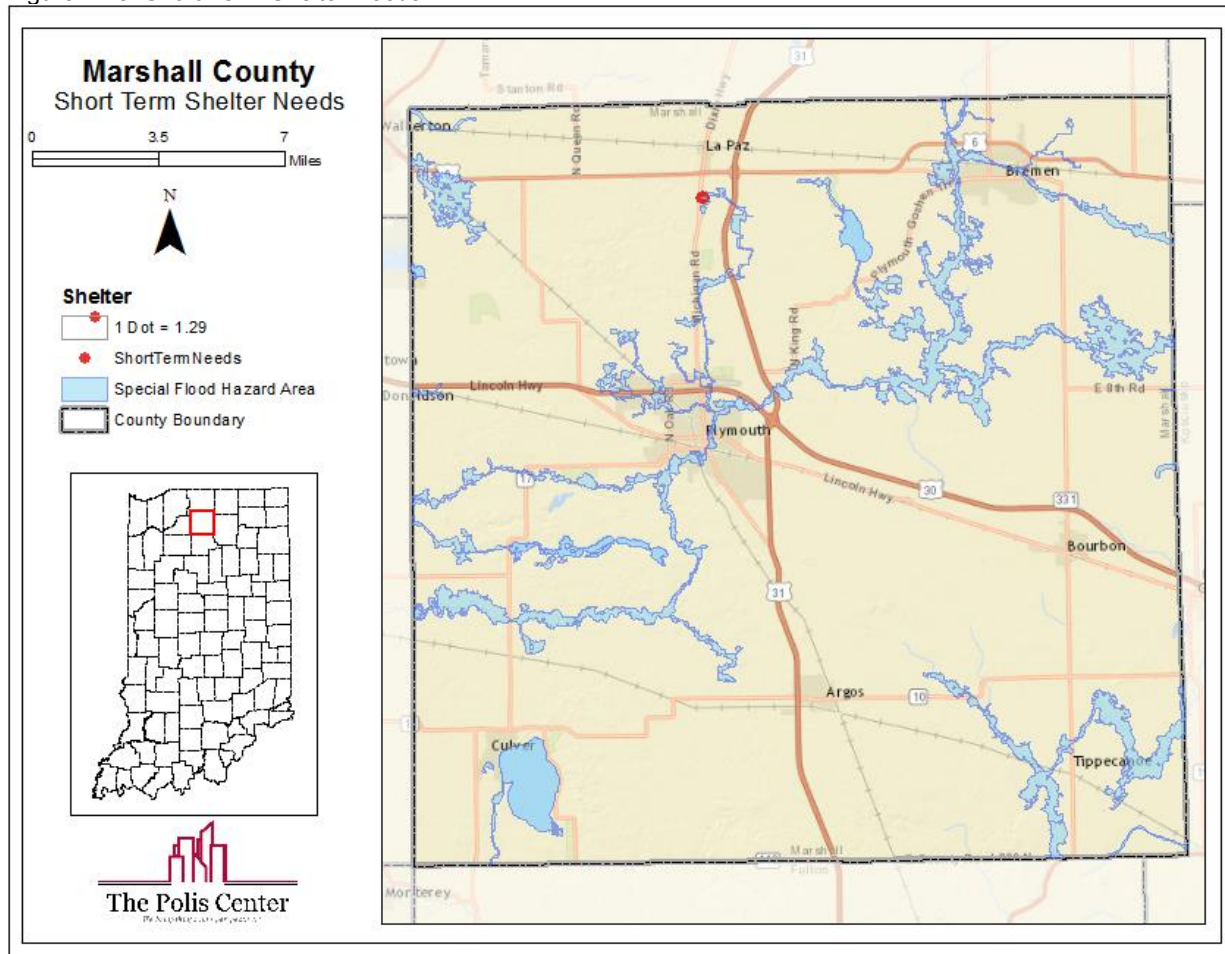
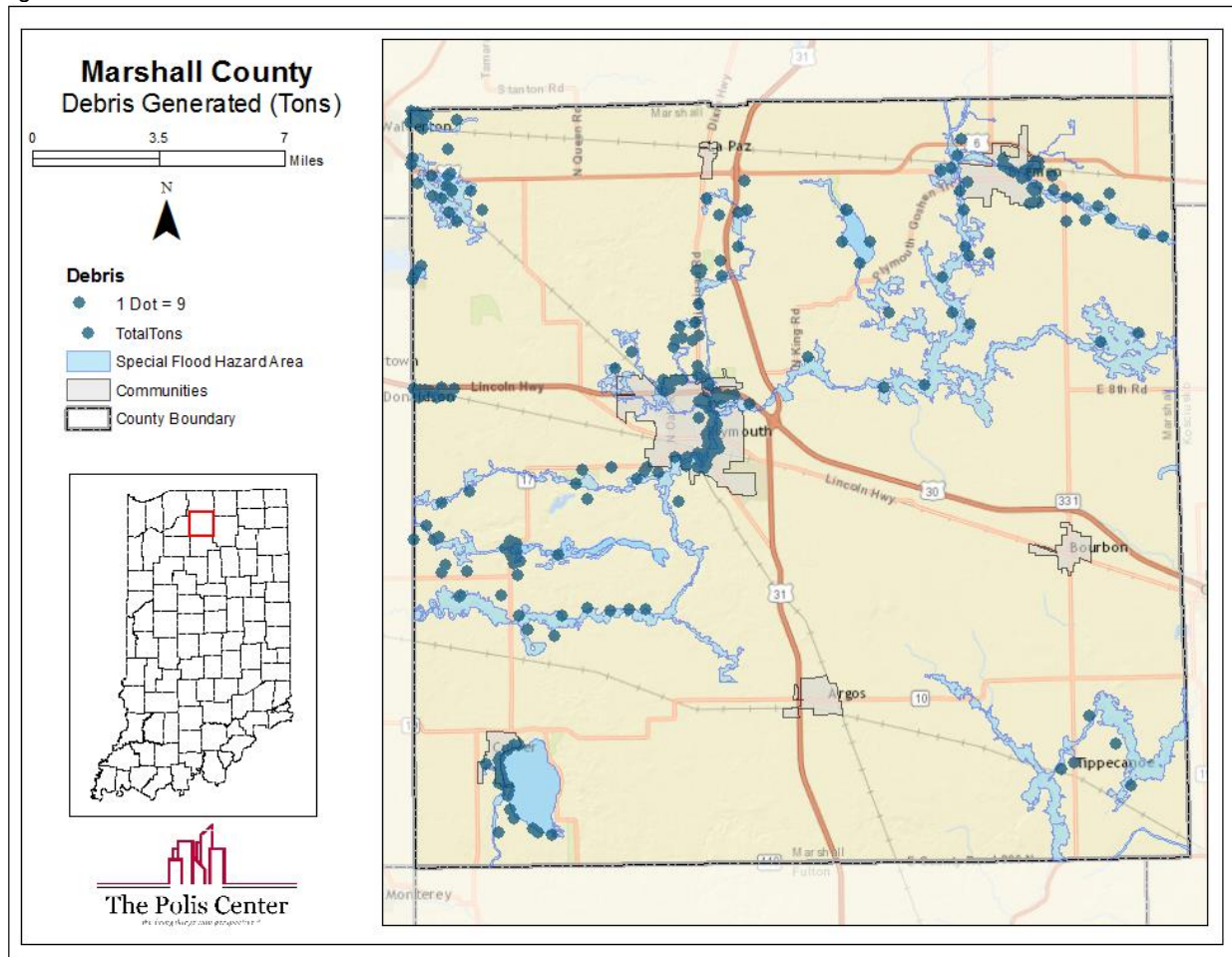


Figure 4-29: Tons of Debris Generated



Relationship to other Hazards

Severe storms and blizzards - Summer storms can potentially lead to log jams. Snow melt can contribute to flooding and, under the right circumstances, flash flooding.

Dam Failure - Flood events can compromise the structural integrity of dams.

Public Health - Public health can be affected as a result of wastewater spills due to flooding or power failures.

Water Main Breaks - Surges in water pressure as a result of water pumps starting after power outages can lead to water main breaks.

Plans and Programs in Place

Floodplain Ordinances - Marshall County and its participating NFIP communities regulate floodway development through their floodplain ordinances. All construction in the floodway requires the prior approval from the DNR Division of Water.

National Flood Insurance Program (NFIP) - The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses.

Road Infrastructure and Drainage - Public Works staff at the county, city and township level work on culvert and ditch maintenance to prevent road flooding. Ice dams and culverts are monitored and addressed to reduce road flooding during spring thaws. The county has put a priority on culvert improvements to avoid road washouts.

Stream Gauging - The National Weather Service and the U.S. Geological Society provide real-time websites that gauge stream flow in area streams and rivers. Yellow river flowage levels for the city of Plymouth can be accessed online and used to inform the public of areas expected to be flooded as the river level rises.

Repetitive Loss Structures - Marshall County has the ability to purchase repetitive loss properties.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the 911 Mass Notification System and the Marshall County Sheriff's Office Facebook page, as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Program Gaps or Deficiencies

Stream Stabilization - Ongoing maintenance and repairs are being developed including unique design measures to include stabilization of the Yellow River in the county.

Beaver Dams and Flood Risk - Beaver dams have impounded many areas with water, and under normal rain events they are not a problem. However, in the event of flash flooding, when beaver dams break, road infrastructure is burdened with a major additional flow of water.

Road and Culvert Improvements - Marshall County strives to constantly improve its road and culvert infrastructure against flooding, but is limited by financial resources to go beyond maintenance on some projects.

4.2 Earthquake

Hazard Description

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. For hundreds of millions of years, the forces of plate tectonics have shaped Earth as the huge plates that form the Earth's surface move slowly over, under, and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free, causing the ground to shake.

Ninety-five percent of earthquakes occur at the plate boundaries; however, some earthquakes occur in the middle of plates, as is the case for seismic zones in the Midwestern US. The most seismically active area in the Central US is referred to as the New Madrid Seismic Zone. Scientists have learned that the New Madrid fault system may not be the only fault system in the central US capable of producing damaging earthquakes. The Wabash Valley Fault System in Indiana shows evidence of large earthquakes in its geologic history, and there may be other currently unidentified faults that could produce strong earthquakes. Figure 4-30 depicts Indiana's historical earthquake epicenters. Tables 4-23 and 4-24 provide guidance on how to interpret the modified Mercalli intensity scale.

Ground shaking from strong earthquakes can collapse buildings and bridges; disrupt gas, electric, and communication (e.g. phone, cable, Internet) services; and sometimes trigger landslides, flash floods, and fires. Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers or homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths, injuries, and extensive property damage.

Figure 4-30: Indiana Historical Earthquake Epicenters

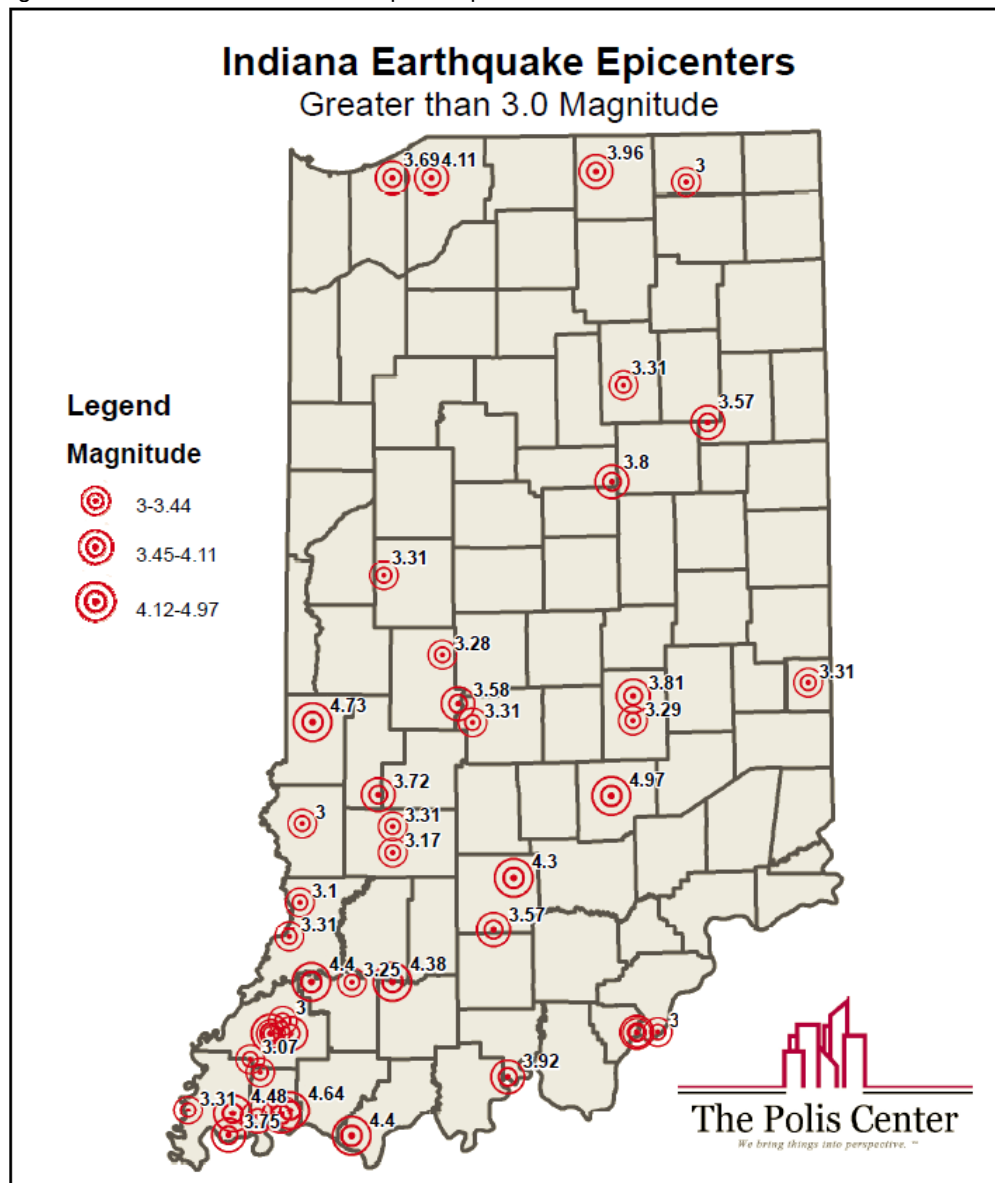


Table 4-21: Abbreviated Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Table 4-22: Earthquake Magnitude vs. Modified Mercalli Intensity Scale

Earthquake Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 - 3.0	I
3.0 - 3.9	II - III
4.0 - 4.9	IV - V
5.0 - 5.9	VI - VII
6.0 - 6.9	VII - IX
7.0 and higher	VIII or higher

Earthquake History in Marshall County

At least 43 earthquakes, M3.0 or greater, have occurred in Indiana since 1817. The last such event was a M3.1 centered just north of Vincennes on May 10, 2010. A M3.8 earthquake occurred near

Kokomo in December later that same year with approximately 10,390 individuals submitting felt reports to the USGS.

The majority of seismic activity in Indiana occurs in the southwestern region of the state. Earthquakes originate just across the boundary in Illinois and can be felt in Indiana. Elkhart and La Porte County adjacent to Marshall County have had earthquakes in the 19th century. The M4.11 event in La Porte County was on February 11, 1899. The Elkhart County event occurred on December 12, 1893 and was recorded as a M3.96.

Vulnerability and Future Development

During an earthquake, the types of infrastructure that could be impacted include roadways, runways, utility lines and pipes, railroads, and bridges. The impacts to these structures include broken, failed, or impassable roadways and runways; broken or failed utility lines, such as loss of power or gas to a community; and railway failure from broken or impassable tracks. Bridges also could fail or become impassable, causing traffic risks and ports could be damaged which would limit the shipment of goods. Typical scenarios are described to gauge the anticipated impacts of earthquakes in the county in terms of numbers and types of buildings and infrastructure.

New construction, especially critical facilities, will accommodate earthquake mitigation design standards. The discussion included strategies to harden and protect future, as well as existing, structures against the possible termination of public services and systems including power lines, water and sanitary lines, and public communication.

Risk Analysis

Combining Available Data and Methods

Four earthquake scenarios—two based on deterministic scenarios and two based on probabilistic scenarios—were developed to provide a reasonable basis for earthquake planning in Marshall County. The first deterministic scenario was a 7.1 magnitude epicenter along the Wabash Valley fault zone. Note that a deterministic scenario, in this context, refers to hazard or risk models based on specific scenarios without explicit consideration of the probability of their occurrences. Shake maps provided by FEMA were used in HAZUS-MH to estimate losses for Marshall County based on this event.

The second deterministic scenario was a Moment Magnitude of 5.5 with the epicenter located in Marshall County. This scenario was selected based upon the opinion of the IGS stating it could occur in the selected location and that it would therefore represent a realistic scenario for planning purposes.

Additionally, the analysis included two different types of probabilistic scenarios. These types of scenarios are based on ground shaking parameters derived from U.S. Geological Survey probabilistic seismic hazard curves. The first probabilistic scenario was a 500-year return period scenario. This scenario evaluates the average impacts of a multitude of possible earthquake epicenters with a magnitude that would be typical of that expected for a 500-year return period. The second probabilistic scenario allowed calculation of annualized loss. The annualized loss analysis in HAZUS-MH provides a means for averaging potential losses from future scenarios while considering their probabilities of occurrence. The HAZUS-MH earthquake model evaluates eight different return period scenarios including those for the 100-, 250-, 500-, 750-, 1000-, 1500-, 2000-, and 2500-year return period earthquake events. HAZUS-MH then calculates the probabilities of these events as well as the interim events, calculates their associated losses, and sums these losses to calculate an annualized loss. These analysis options were chosen because they are useful for prioritization of seismic reduction measures and for simulating mitigation strategies.

The following earthquake hazard modeling scenarios were performed:

- 7.1 magnitude earthquake on the Wabash Valley Fault System
- 5.5 magnitude earthquake local epicenter
- 500-year return period event
- Annualized earthquake loss

Modeling a deterministic scenario requires user input for a variety of parameters. One of the most critical sources of information that is required for accurate assessment of earthquake risk is soils data. Fortunately, a National Earthquake Hazards Reduction Program (NEHRP) soil classification map exists for Indiana. NEHRP soil classifications portray the degree of shear-wave amplification that can occur during ground shaking. The IGS supplied soils map was used for the analysis. FEMA provided a map for liquefaction potential that was used by HAZUS-MH.

An earthquake depth of 10.0 kilometers was selected based on input from IGS. HAZUS-MH also requires the user to define an attenuation function unless ground motion maps are supplied. Because Marshall County has experienced smaller earthquakes, the decision was made to use the

Central Eastern United States (CEUS) attenuation function. The probabilistic return period analysis and the annualized loss analysis do not require user input.

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

Results for 7.1 Magnitude Earthquake Wabash Valley Scenario

The results of the 7.1 Wabash Valley earthquake are depicted in Table 4-23, Table 4-24, and Figure 4-31. HAZUS-MH estimates that approximately 12 buildings will be at least moderately damaged. This is less than 1% of the total number of buildings in the region. It is estimated that no buildings will be damaged beyond repair.

The total building related losses totaled \$106.47 million; the estimated losses did not cause significant business interruption to the region. By far, the largest loss was sustained by the residential occupancies, which made up more than 37% of the total loss.

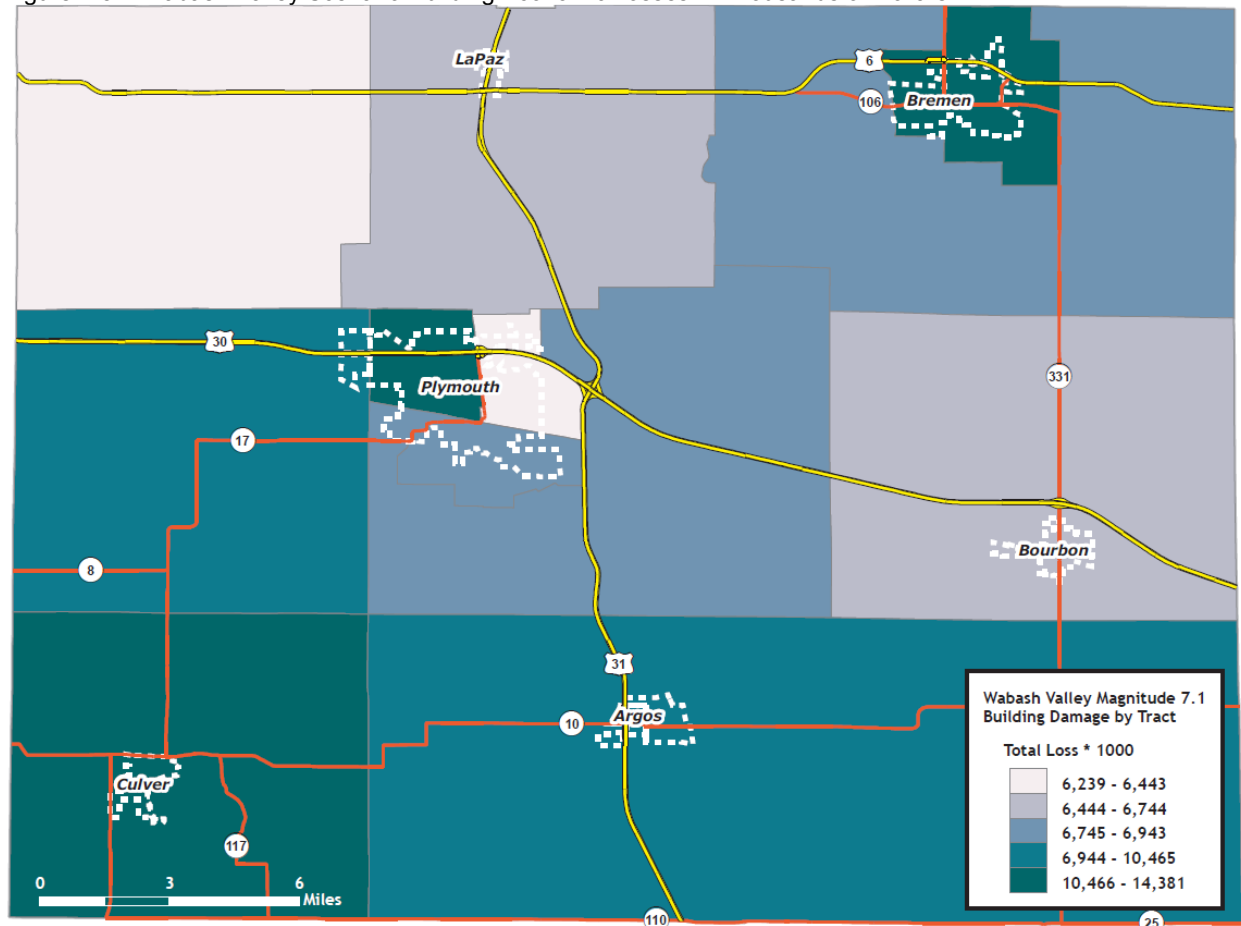
Table 4-23: Wabash Valley Scenario-Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3,727	18.51	40	24.69	3	28.12	0	0.00	0	0.00
Commercial	1,012	5.03	9	5.70	1	5.88	0	0.00	0	0.00
Education	56	0.28	1	0.39	0	0.38	0	0.00	0	0.00
Government	94	0.47	1	0.60	0	0.61	0	0.00	0	0.00
Industrial	282	1.40	3	1.65	0	1.90	0	0.00	0	0.00
Other Residential	2,819	14.00	45	27.85	3	28.41	0	0.00	0	0.00
Religion	412	2.05	5	2.99	0	3.10	0	0.00	0	0.00
Single Family	11,728	58.26	58	36.13	4	31.60	0	0.00	0	0.00
Total	20,130		161		12		0		0	

Table 4-24: Wabash Valley Scenario-Building Economic losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.00	0.01	0.00	0.02	0.03
	Capital-Related	0.00	0.00	0.01	0.00	0.01	0.02
	Rental	0.01	0.00	0.02	0.00	0.00	0.03
	Relocation	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	0.01	0.00	0.04	0.01	0.03	0.08
Capital Stock Losses							
	Structural	0.05	0.01	0.02	0.01	0.09	0.18
	Non_Structural	19.42	2.65	6.36	8.63	17.12	54.18
	Content	15.96	1.54	6.13	5.31	17.79	46.73
	Inventory	0.00	0.00	0.40	3.37	1.53	5.29
	Subtotal	35.43	4.20	12.91	17.32	36.53	106.39
	Total	35.44	4.20	12.95	17.33	36.56	106.47

Figure 4-31: Wabash Valley Scenario-Building Economic Losses in Thousands of Dollars



Wabash Valley Scenario—Essential Facility Losses

Before the earthquake, the region had 946 care beds available for use. On the day of the earthquake, the model estimates that only 437 (46%) care beds are available for use by patients already in

medical care facilities and those injured by the earthquake. After one week, 97% of the beds will be back in service. By day 30, 100% will be operational.

Results for 5.5 Magnitude Earthquake in Marshall County

The results of the initial analysis, the 5.5 magnitude earthquake with an epicenter under the courthouse, are depicted in Tables 4-25 and 4-26 and Figure 4-32. HAZUS-MH estimates that approximately 3,839 buildings will be at least moderately damaged—approximately 19% of the total number of buildings in the region. It is estimated that 157 buildings will be damaged beyond repair.

The total building related losses totaled \$285.85 million; 9% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which comprised more than 41% of the total loss.

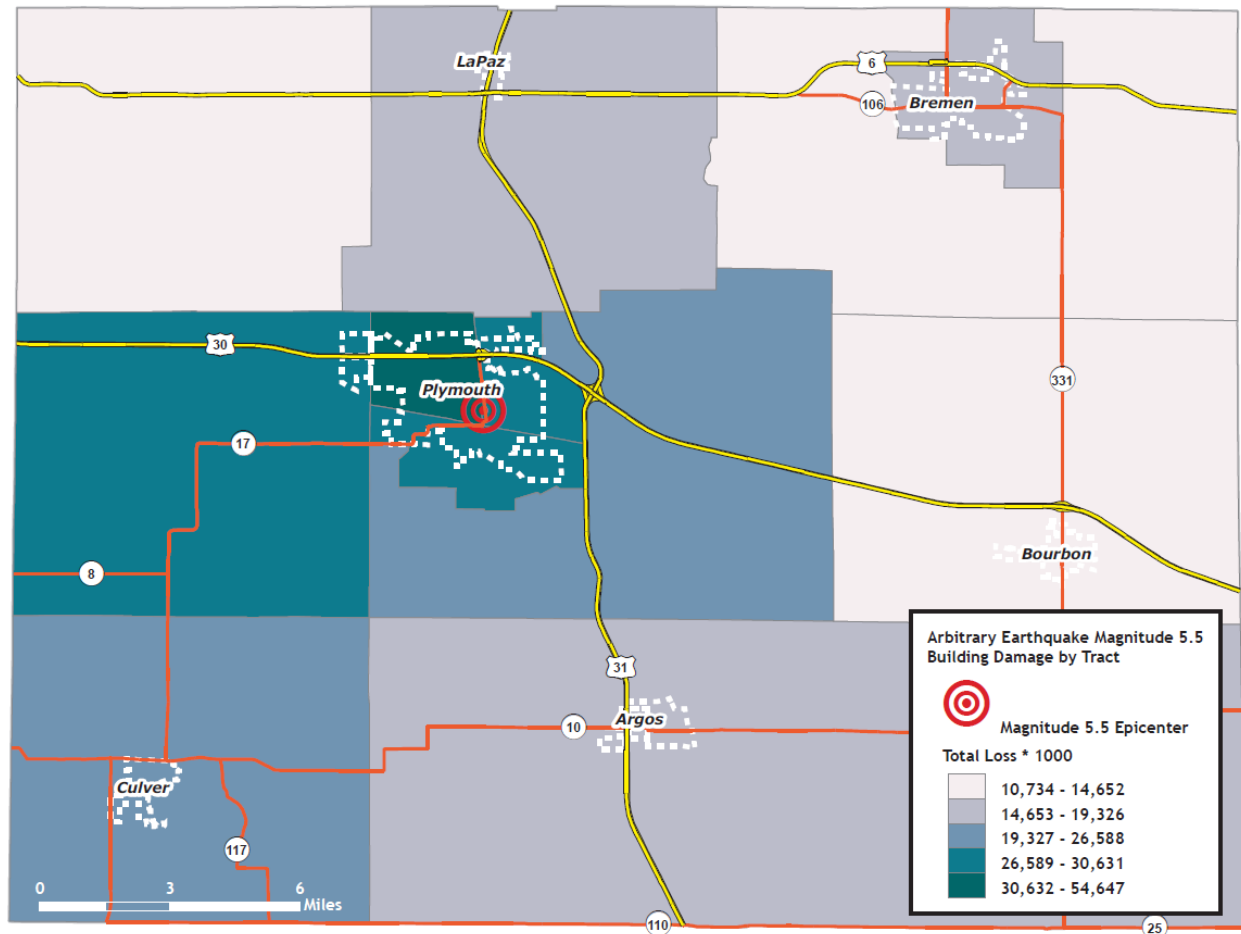
Table 4-25: Marshall County 5.5M Scenario-Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	2,136	18.11	729	15.61	644	22.52	227	27.55	35	22.05
Commercial	544	4.61	216	4.63	183	6.41	66	8.01	13	8.07
Education	35	0.29	11	0.23	8	0.29	3	0.30	1	0.37
Government	55	0.47	18	0.39	16	0.55	5	0.56	1	0.76
Industrial	158	1.34	53	1.14	51	1.80	20	2.39	3	1.94
Other Residential	1,470	12.47	643	13.79	555	19.42	170	20.66	28	17.57
Religion	226	1.92	90	1.93	69	2.42	25	3.09	6	3.81
Single Family	7,172	60.80	2,907	62.27	1,331	46.58	309	37.44	71	45.41
Total	11,796		4,668		2,857		825		157	

Table 4-26: 5.5M Scenario-Building Economic Losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.71	4.60	1.56	2.24	9.11
	Capital-Related	0.00	0.29	4.66	0.95	0.96	6.86
	Rental	2.73	0.64	4.32	0.92	1.44	10.06
	Relocation	0.32	0.01	0.24	0.09	0.43	1.09
	Subtotal	3.05	1.66	13.82	3.52	5.07	27.12
Capital Stock Losses							
	Structural	12.98	1.21	5.39	3.21	19.81	42.60
	Non_Structural	61.09	7.07	15.98	15.18	31.37	130.70
	Content	28.05	2.73	11.24	8.71	25.98	76.71
	Inventory	0.00	0.00	0.74	5.82	2.18	8.73
	Subtotal	102.12	11.01	33.35	32.92	79.34	258.73
	Total	105.17	12.66	47.17	36.44	84.41	285.85

Figure 4-32: 5.5M Scenario-Building Economic Losses in Thousands of Dollars



Marshall County 5.5M Scenario—Essential Facility Losses

Before the earthquake, the region had 946 care beds available for use. On the day of the earthquake, the model estimates that only 22 care beds (2%) are available for use by patients already in medical care facilities and those injured by the earthquake. After one week, 44% of the beds will be back in service. By day 30, 74% will be operational.

Results 5.0 Magnitude 500-Year Probabilistic Scenario

The results of the 500-year probabilistic analysis are depicted in Tables 4-27 and 4-28. HAZUS-MH estimates that approximately 235 buildings will be at least moderately damaged. This is more than 1% of the total number of buildings in the region. It is estimated that two buildings will be damaged beyond repair.